

N 62 12324

NASA TN D-1116

077-17111 V62A1



TECHNICAL NOTE

D-1116

THE RESULTS OF EMITTANCE MEASUREMENTS MADE IN
RELATION TO THE THERMAL DESIGN OF EXPLORER SPACECRAFT

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and Klaus Schocken

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON

May 1962

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SUMMARY

This note consists of a summary of the emittance measurements made thus far by Baird-Atomic, Incorporated, under contract DA-19-020-ORD-4474, and supervised by D. Klaus Schocken of MSFC's Research Projects Division. Spectral emittance measurements were made over the range of 0.4 to 13.5 microns and total normal measurements were made at 275 degrees Kelvin. An excerpt from the "Final Technical Report" by R. McDonough, director of the project at Baird-Atomic, Incorporated, is given as an Appendix to this note.

SECTION I. INTRODUCTION

The hemispherical spectral reflectance measurements from 0.4 to 3.5 microns are given in Data Section III, and the normal spectral emissivity measurements from 4.0 to 13.5 microns at 360 degrees Kelvin are given in Data Section IV.

A summary of the results obtained on each batch of samples is given in Data Section II. The hemispherical spectral reflectance measurements from 0.4 to 3.5 microns were integrated with respect to a black-body curve at 6,000 degrees Kelvin and the results subtracted from 1 to give an effective solar absorptivity, α . The normal spectral emittance measurements from 4.0 to 13.5 microns were integrated with respect to a black-body curve at 360 degrees Kelvin to give an effective emittance, ϵ_I . In both cases, the data was extrapolated by assuming values equal to the nearest measured value. The "code" gives the location in Data Sections III and IV of the spectral values which were integrated to give α and ϵ_I . The total normal emittance at 275 degrees Kelvin, ϵ_T is also given when it was measured. The difference between the total

normal emittance and the integrated emittance is primarily due to the fact that the integrated value was integrated with respect to a black-body curve at 360 degrees Kelvin and that the data had to be extrapolated past 13.5 microns, which accounts for 50% of the energy of the black-body curve.

Some of the spectral data has been given by Dr. Schocken in reports listed in the references. The samples with the satin finish treatment were prepared by Mr. A. W. Smock of MSFC's Structures and Mechanics Division, who will give a detailed description of this treatment in a forthcoming report. Mr. Smock also prepared most of the Rokide samples. Mr. G. A. Zerlaut, also of Structures and Mechanics Division, prepared most of the coating samples, some of which are discussed in his referenced reports.

The measurements reported herein were made over a four-year period in relation to the thermal design of Explorer satellites. Many of the measurements were of an exploratory or screening nature, and thus very little if any information is available regarding detailed descriptions of the surfaces. Also, the purpose of many of the measurements was to determine the radiation characteristics of surfaces already in existence. Consequently, there was no exact information available as to surface preparation. Therefore, it is apparent that much of the information in this report will be of qualitative rather than quantitative use.

Some of the hemispherical spectral reflectance measurements were made by A. C. Krupnick of Structures and Mechanics Division using the integrating sphere discussed in reference 7.

The numerical integration of the spectral values was done on an IBM 7090 computer by Mrs. Billie S. Robertson of the Computation Division.

DATA SECTION I
SUMMARY OF RESULTS

DATE OF MEASUREMENT: 11-60

TABLE 1. ANODIZED ALUMINUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
341	423	0.80		0.67		1.2	
	424			0.67			

GENERAL REMARKS: Was to be used for solar cell plates on Payload S-45

DATE OF MEASUREMENT: 9-58

TABLE 2. MACHINED ALUMINUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
61		0.37					Normal
68	192	0.37	0.079		4.68		Normal
	193		0.050				15°
	194		0.040				30°
	195		0.13				45°
	196		0.25				60°

DATE OF MEASUREMENT: 7-57

TABLE 3. 2S ALUMINUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
19	100	0.48	0.31	0.27	1.55	1.78	Sandblasted
18		0.29					Polished

GENERAL REMARKS: Commercial sandblasting process using silicon grit.

DATE OF MEASUREMENT: 12-59

TABLE 4. SANDBLASTED ALUMINUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
42	122	0.52	0.36	0.30	1.44	1.73	1 Pass
43	123	0.52	0.34	0.31	1.52	1.67	
44	124	0.55	0.36	0.39	1.53	1.41	2 Passes
45	125	0.55	0.36	0.37	1.53	1.48	

GENERAL REMARKS: Satin finish treatment

DATE OF MEASUREMENT: 1-60

TABLE 5. SANDBLASTED 6061-T6 ALUMINUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
1	108	0.52	0.32	0.33	1.63	1.57	
2	109	0.53	0.31	0.30	1.71	1.76	Uncoated
3	110	0.53	0.31	0.30	1.71	1.76	
4	111	0.54	0.31	0.29	1.74	1.86	
5	112	0.53	0.31	0.28	1.71	1.89	Coated
6	113	0.54	0.30	0.29	1.80	1.86	

GENERAL REMARKS: These measurements were made to determine whether or not a strippable plastic coating, used to protect the surface from environmental effects, would have any effect on the radiative characteristics of the surface. The "coated" surfaces were stripped before the measurements were made. The coating was obtained from Lister Laboratories and is known as a "Clear Liquid Plastic Vellum."

DATE OF MEASUREMENT: 9-60

TABLE 5A. SANDBLASTED 6061-T6 ALUMINUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
324	404	0.49	0.20	0.32	2.45	1.53	3 inches from top of cone
325	404	0.49	0.20	0.31	2.45	1.58	3 inches from top of cone
326	405	0.48	0.20	0.33	2.40	1.45	1 inch from top of cone
327	405	0.49	0.20	0.32	2.45	1.53	1 inch from top of cone
328	406	0.50	0.20	0.31	2.50	1.61	5 inches from top of cone
329	406	0.50	0.20	0.29	2.50	1.72	5 inches from top of cone
330	407	0.50	0.20	0.30	2.50	1.67	9 inches from top of cone
331	407	0.51	0.20	0.30	2.55	1.70	9 inches from top of cone
332	408	0.50	0.24	0.31	2.08	1.61	13 inches from top of cone
333	408	0.50	0.24	0.32	2.08	1.56	13 inches from top of cone

GENERAL REMARKS: Aluminum samples placed on a mock-up cone like payload S-30 and sandblasted in the same manner as S-30.

DATE OF MEASUREMENT: 8-60

TABLE 6. TEST OF STRIPPABLE COATING SANDBLASTED 6061-T6 ALUMINUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
319	400	0.53	0.29	0.34	1.83	1.56	Uncoated
320	400	0.52	0.29	0.32	1.79	1.63	Uncoated
317	401	0.51	0.27	0.33	1.89	1.54	Coated
318	401	0.51	0.27		1.89		Coated
314	397	0.53	0.30	0.34	1.77	1.56	Uncoated
315	398	0.52	0.31	0.34	1.68	1.53	Coated } heated at 100° C
316	399	0.51	0.28	0.32	1.82	1.59	Coated } for 7 hours
321	402	0.54	0.28	0.37	1.93	1.46	Uncoated
322	403	0.52	0.26	0.33	2.00	1.58	Coated } Cooled at -20° C
323	403	0.51	0.26	0.34	1.96	1.50	Coated } for 7 hours

GENERAL REMARKS: All coated surfaces were stripped before measuring.
 All surfaces were cleaned with zylene before measuring. α measurements were made by Structures and Mechanics.

DATE OF MEASUREMENT: 9-60

TABLE 7. S-30 PAYLOAD SANDBLASTED ALUMINUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
334	409	0.50	0.27	0.33	1.85	1.52	3" from top of cone, flight #1
	410		0.25	0.33			3" from top of cone, flight #2
	411		0.28	0.32			equator, flight #2
	412		0.26	0.34			equator, flight #2
	413		0.28	0.32			equator, flight #2
	414		0.27	0.36			equator, flight #2
	415		0.28	0.35			equator, flight #2
	416		0.28	0.33			equator, flight #2

GENERAL REMARKS: Samples placed on actual payload during sandblast.
 α measurements made by Structures and Mechanics.

DATE OF MEASUREMENT: 4-58

TABLE 8. PLAIN Aluminum Foil

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
28	126	0.20	0.12	0.05	1.67	4.0	
28	127	0.20	0.11		1.81		

GENERAL REMARKS: 3-S alloy, 0.004-inch thick, cemented to fiberglass.

DATE OF MEASUREMENT: 12-58

TABLE 8A. PLAIN Aluminum Foil

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
164	273	0.18	0.06		3.00		As received
165	274	0.18	0.08		2.25		Solvent rinsed
166	275	0.18	0.07		2.57		Alkaline cleaned
167	267	0.15	0.07		2.14		Deoxidized

GENERAL REMARKS: 3-S alloy, 0.004-inch thick, cemented to fiberglass.

DATE OF MEASUREMENT: 12-58

Table 9. Plain and Sandblasted Aluminum Foil

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
158	276	0.26	0.073		3.56		Plain
159	268	0.37	0.076		4.87		
160	269	0.47	0.25		1.88		1 Pass
161	270	0.45	0.25		1.80		
162	271	0.47	0.31		1.51		2 Passes
163	272	0.46	0.32		1.43		
156	265	0.50	0.31		1.61		4 Passes
157	266	0.50	0.31		1.61		

GENERAL REMARKS: 3-S foil cemented to #316 stainless steel and given satin finish treatment.

DATE OF MEASUREMENT: 3-59

TABLE 10. SANDBLASTED ALUMINUM FOIL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
138	247	0.40	0.21		1.90		} 1 Pass
139	248	0.40	0.19		2.10		
140	249	0.43	0.23	0.23	1.86		} 2 Passes
141	250	0.43	0.22	0.24	1.95		
142	251	0.47	0.24		1.95		} 4 Passes
143	252	0.47	0.23		2.04		

GENERAL REMARKS: Given satin finish treatment after cementing to fiberglass.

DATE OF MEASUREMENT: 3-59

TABLE 10A. SANDBLASTED ALUMINUM FOIL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
150	259	0.38	0.18		2.11		} 1 Pass
151	260	0.39	0.19		2.05		
152	261	0.42	0.20		2.10		} 2 Passes
153	262	0.42	0.21		2.00		
154	263	0.45	0.22		2.04		} 4 Passes
155	264	0.45	0.22		2.04		

GENERAL REMARKS: Cemented to fiberglass and coated with strippable coating after satin finish treatment.

DATE OF MEASUREMENT: 3-59

TABLE 10B. SANDBLASTED ALUMINUM FOIL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
144	253	0.37	0.21		1.76		1 Pass
145	254	0.37	0.20		1.85		
146	255	0.41	0.20	0.23	2.05	1.78	2 Passes
147	256	0.41	0.19	0.23	2.15	1.78	
148	257	0.46	0.26		1.76		4 Passes
149	258	0.46	0.23		2.00		

GENERAL REMARKS: Given satin finish treatment prior to cementing to fiberglass.

DATE OF MEASUREMENT: 7-59

TABLE 11. BERYLLIUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
194	304	0.49	0.040		12.25		Polished
195	305	0.70	0.11		6.36		Sandblasted

DATE OF MEASUREMENT: 7-59

TABLE 12. CHROMIUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
192	302	0.34	0.051	0.06	6.67	5.7	Polished
193	303	0.44	0.057	0.12	7.72	3.7	Sandblasted

DATE OF MEASUREMENT: 10-60

TABLE 13. ELECTRICAL CONDUCTIVE SILVER PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
345	417	0.32		0.48		0.67	
	418			0.48			
	419			0.50			
	420			0.53			
343	421	0.33		0.49		0.65	Control
344	422	0.31		0.38		0.82	Exposed to U.V. & vacuum

GENERAL REMARKS: This paint was used on Payload S-30, EXPLORER VIII.

DATE OF MEASUREMENT: 9-59

TABLE 14. GREEN PASTEL (SERIES) RCOG PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
γ	ϵ						
255	369	0.75	0.89	0.73	0.84	1.03	RCOG-30 100*
256	370	0.75	0.86	0.74	0.87	1.01	
257	371	0.48	0.89	0.64	0.54	0.75	RCOG-30/10 10*
258	372	0.48	0.85	0.73	0.56	0.66	
259	373	0.56	0.86	0.68	0.65	0.82	RCOG-30/20 20*
260	374	0.55	0.86	0.72	0.64	0.76	
261	375	0.62	0.89	0.71	0.70	0.87	RCOG-30/30 30*
262	376	0.61	0.88	0.71	0.69	0.86	

GENERAL REMARKS: Pigment volume concentration = 30% PVC

Vehicle = Dow Corning 808 Silicone Resin

Coating Thickness = 3 mils

Substrata = Wet Blasted Copper

*Volume % Cr₂O₃ in pigment, remainder rutile TiO₂

DATE OF MEASUREMENT: 9-59

TABLE 15. GRAY RRB PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
211	318	0.56	0.87	0.84	0.64	0.67	RRB-1 1*
212	319	0.56	0.88	0.81	0.64	0.69	
213	320	0.72	0.91	0.71	0.79	1.01	RRB-3 3*
214	321	0.72	0.90	0.71	0.80	1.01	
215	322	0.80	0.87	0.74	0.92	1.08	RRB-6 6*
216	323	0.80	0.86	0.76	0.93	1.05	

GENERAL REMARKS: Pigment volume concentration = 23% PVC

Vehicle = Dow Corning 808 Silicone Resin + 2% TBT

Coating Thickness = 3 mils

Substrata = Wet Blasted Copper

*Volume % carbon black in pigment, remainder rutile TiO_2

DATE OF MEASUREMENT: 9-59

TABLE 16. RED AND WHITE PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
239	353	0.30	0.84	0.68	0.36	0.44	R-45 45% rutile TiO *
240	354	0.29	0.85	0.73	0.34	0.40	
241	355	0.28	0.84	0.67	0.33	0.42	R-50 50% rutile TiO *
242	356	0.28	0.84	0.68	0.33	0.41	
243	357	0.76	0.91	0.78	0.84	0.97	RIO-20 20% red iron oxide
244	358	0.76	0.88	0.76	0.86	1.00	
245	359	0.76	0.85	0.73	0.89	1.04	RIO-30 30% red iron oxide
246	360	0.76	0.87	0.70	0.87	1.09	

GENERAL REMARKS: *Pigment Volume Concentration

Vehicle = Dow Corning 808 Silicone

Coating Thickness = 3 mils

Substrata = Wet Blasted Copper

DATE OF MEASUREMENT: 9-59

TABLE 17. SPECIAL BLACK SPS PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
263	324	0.94	0.81	0.69	1.16	1.36	
264	325	0.95	0.81	0.68	1.17	1.40	

GENERAL REMARKS: Pigment = Black lead sulfide at 30% PVC
 Vehicle = Dow Corning 808 Silicone Resin
 Coating Thickness = 3 mils
 Substrata = Wet Blasted Copper

DATE OF MEASUREMENT: 9-59

TABLE 18. RED PASTEL (SERIES) RRIO PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
247	361	0.51	0.86	0.74	0.59	0.69	{ 30/5 5*
248	362	0.51	0.85	0.72	0.60	0.71	
249	363	0.58	0.82	0.75	0.71	0.77	{ 30/10 10*
250	364	0.58	0.82	0.68	0.71	0.85	
251	365	0.66	0.87	0.64	0.76	1.03	{ 30/25 25*
252	366	0.65	0.81	0.63	0.80	1.03	
253	367	0.70	0.91	0.71	0.77	0.99	{ 30/50 50*
254	368	0.70	0.92	0.74	0.76	0.95	

GENERAL REMARKS: Pigment volume concentration = 30% PVC
 Vehicle = Dow Corning 808 Silicone Resin
 Coating Thickness = 3 mils
 Substrata = Wet Blasted Copper
 *Volume % red iron oxide in pigment, remainder rutile TiO_2

DATE OF MEASUREMENT: 9-59

TABLE 19. WHITE R-40 PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
237	351	0.28	0.87	0.68	0.32	0.41	
238	352	0.27	0.87	0.66	0.31	0.41	

GENERAL REMARKS: Pigment = rutile TiO_2 at 40% PVC

Vehicle = Dow Corning 808 Silicone Resin

Coating Thickness = 3 mils

Substrata = Wet Blasted Copper

DATE OF MEASUREMENT: 9-59

TABLE 20. WHITE R-35 PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
235	349	0.27	0.86	0.75	0.31	0.36	
236	350	0.26	0.87	0.67	0.30	0.39	

GENERAL REMARKS: Pigment = Rutile TiO_2 at 35% PVC

Vehicle = Dow Corning 808 Silicone Resin

Coating Thickness = 3 mils

Substrata = Wet Blasted Copper

DATE OF MEASUREMENT: 9-59

TABLE 21. WHITE R-30 PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
229	347	0.26	0.87	0.69	0.30	0.38	
230	348	0.25	0.87	0.71	0.29	0.35	

GENERAL REMARKS: Pigment = Rutile TiO_2 at 30% PVC
 Vehicle = Dow Corning 808 Silicone Resin
 Coating Thickness = 3 mils
 Substrata = Wet Blasted Copper

DATE OF MEASUREMENT: 9-59

TABLE 22. WHITE R-25 PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
227	345	0.24	0.87	0.73	0.28	0.33	
228	346	0.25	0.87	0.69	0.29	0.36	

GENERAL REMARKS: Pigment = Rutile TiO_2 at 25% PVC
 Vehicle = Dow Corning 808 Silicone Resin
 Coating Thickness = 3 mils
 Substrata = Wet Blasted Copper

DATE OF MEASUREMENT: 9-59

TABLE 23. WHITE R-20 PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
225	342	0.25	0.88	0.79	0.28	0.32	
226	343	0.24	0.88	0.69	0.27	0.35	
225	344	0.25	0.88	0.72	0.28	0.35	

GENERAL REMARKS: Pigment = Rutile TiO_2 at 20% PVC
 Vehicle = Dow Corning 808 Silicone Resin
 Coating Thickness = 3 mils
 Substrata = Wet Blasted Copper

DATE OF MEASUREMENT: 9-59

TABLE 24. WHITE R-15 PAINT COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
223	339	0.24	0.86	0.73	0.28	0.33	
224	340	0.24	0.86	0.71	0.28	0.34	
224	341	0.24	0.87	0.77	0.28	0.31	

GENERAL REMARKS: Pigment = Rutile TiO_2 at 15% PVC
 Vehicle = Dow Corning 808 Silicone Resin
 Coating Thickness = 3 mils
 Substrata = Wet Blasted Copper

DATE OF MEASUREMENT: 3-59

TABLE 25. ENAMEL XXX COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
131	224	0.80	0.85	0.72	0.94	1.11	
132	225	0.80	0.85	0.77	0.94	1.04	
133	226	0.81	0.83	0.73	0.98	1.11	

DATE OF MEASUREMENT: 3-59

TABLE 26. GOLD ENAMEL XXX COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
128	221	0.35	0.07	0.13	5.00	2.69	
129	222	0.35	0.06	0.13	5.83	2.69	
130	223	0.35	0.07	0.14	5.00	2.50	

GENERAL REMARKS: Jupiter flame shield process

DATE OF MEASUREMENT: 2-58

TABLE 27. COATING 195

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
25	13	0.22	0.91		0.24		
26	14	0.21	0.94		0.22		
	15		0.88				
	16		0.90				

DATE OF MEASUREMENT: 2-58

TABLE 28. COATING 197

CODE		α	ϵ_I	ϵ_T	γ/ϵ_I	γ/ϵ_T	COMMENTS
α	ϵ						
12	9	0.23	0.90		0.26		
13	10	0.23	0.89		0.26		
	17		0.84				
	18		0.87				

DATE OF MEASUREMENT: 2-58

TABLE 29. COATING 199

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
14	11	0.16	0.93		0.17		
24	12	0.15	0.93		0.16		Normal
	59		0.83				15°
	60		0.82				30°
	61		0.82				45°
	62		0.80				60°

DATE OF MEASUREMENT: 5-58

TABLE 30. X-210 LAMINATED FIBERGLASS

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
107	146	0.82	0.86		0.95		X-210-A
108	147	0.83	0.84		0.99		
109	148	0.68	0.84		0.81		X-210-B
110	149	0.68	0.86		0.79		
111	150	0.82	0.85		0.96		X-210-C
112	151	0.81	0.87		0.93		

DATE OF MEASUREMENT: 11-57

TABLE 31. PLASTIC FIBERGLASS

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
309		0.52					Plain
308		0.57					1 Sandblast
306		0.60					2 Sandblast
310		0.51					Plain
307		0.57					1 Sandblast

GENERAL REMARKS: Commercial sandblasting process using silicon grit.

DATE OF MEASUREMENT: 2-60

TABLE 32. 0.006-INCH THICK COATED GLASS

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
	385		0.86	0.53			Side 1
	386		0.84	0.52			Side 2
	387		0.85				Side 1
	388		0.83				Side 2

GENERAL REMARKS: Glass slides used for solar cell covers on payloads S-46 and S-45.

DATE OF MEASUREMENT: 7-59

TABLE 33. GOLD

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
190	300	0.26	0.037	0.03	7.03	8.67	Polished
191	301	0.48	0.097	0.14	4.95	3.43	Sandblasted

DATE OF MEASUREMENT: 2-60

TABLE 34. GOLD, VAPORIZED ON SUBSTRATES

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
52		0.32					Aluminum
53		0.29					Titanium
54		0.31					Stainless steel
55		0.32					Fiberglass

GENERAL REMARKS: Samples prepared by Optical Coating Laboratory.

DATE OF MEASUREMENT: 3-59

TABLE 35. POLISHED GOLD FOIL CEMENTED TO FIBERGLASS

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
134	239	0.36	0.09		4.00		
135	240	0.31	0.09		3.42		
136	241	0.37	0.09		4.11		
137	242	0.33	0.08		4.12		

DATE OF MEASUREMENT: 3-60

TABLE 36. HASS COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
63	389	0.54	0.19	0.17	2.84	3.2	Plain
61	390	0.62	0.20	0.22	3.10	2.8	Light
60	391	0.62	0.26	0.25	2.38	2.5	Medium
62	392	0.53	0.29	0.29	1.83	1.9	Heavy

GENERAL REMARKS: Prepared by Dr. Hass on an opaque aluminum base:
 SiO (0.65μ) + Ge (220 AU) + SiO (600 AU)

Given satin finish treatment with nozzle at 4, 2, and 1 inches from sample.

DATE OF MEASUREMENT: 8-59

TABLE 37. ANODIZED DOW 17 MAGNESIUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
231	314	0.86	0.91		0.94		Heavy
232	315	0.86	0.91		0.94		
233	316	0.70	0.55		1.27		Light
234	317	0.70	0.53		1.32		

GENERAL REMARKS: Use for solar cell plates on payloads S-46 and S-45.

DATE OF MEASUREMENT: 4-58

TABLE 38. M-1 MAGNESIUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
117	142	0.19	0.15		1.27		Polished
118	143	0.23	0.16		1.44		
77	144	0.65	0.51		1.27		Sandblasted
78	145	0.65	0.51		1.27		

DATE OF MEASUREMENT: 4-58

TABLE 39. HK-31 MAGNESIUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
113	138	0.25	0.18		1.39		Polished
114	139	0.22	0.16		1.38		
115	140	0.63	0.59		1.07		Sandblasted
116	141	0.66	0.56		1.18		

DATE OF MEASUREMENT: 8-59

TABLE 40. SANDBLASTED Mg, SS WHITE SATIN FINISH TREATMENT

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
208	310	0.57	0.38		1.50		Sandblasted
209	311	0.56	0.40		1.40		2 Passes

DATE OF MEASUREMENT: 7-58

TABLE 41. HEAT 44 BATTELLE MEMORIAL INST., ALLOY Mg-Li

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
119	172	0.81	0.66		1.23		
120	173	0.79	0.65		1.22		
121	174	0.81	0.62		1.31		

DATE OF MEASUREMENT: 7-58

TABLE 42. HEAT 46 BATTELLE MEMORIAL INST., ALLOY Mg-Li

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
122	175	0.87	0.70		1.24		
123	176	0.88	0.78		1.12		
124	177	0.86	0.74		1.16		

DATE OF MEASUREMENT: 7-58

TABLE 43. HEAT 47 BATTELLE MEMORIAL INST., ALLOY Mg-Li

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
71	178	0.83	0.54		1.54		
72	179	0.87	0.64		1.36		
73	180	0.87	0.63		1.38		

DATE OF MEASUREMENT: 7-58

TABLE 44. HEAT 50 BATTELLE MEMORIAL INST., ALLOY Mg-Li

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
15	181	0.85	0.74		1.15		
16	182	0.85	0.72		1.18		
17	183	0.86	0.61		1.41		

DATE OF MEASUREMENT: 7-58

TABLE 45. HEAT 51-A BATTELLE MEMORIAL INST., ALLOY Mg-Li

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
125	184	0.87	0.81		1.07		
126	185	0.87	0.80		1.09		
127	186	0.88	0.81		1.09		

DATE OF MEASUREMENT: 1-59

TABLE 46. HOT ROLLED CONDITION BATTELLE MEMORIAL INST., Mg-9Li-1Al

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
174	283	0.42	0.14		3.00		
175	284	0.42	0.14		3.00		Normal
176	285	0.42	0.14		3.00		
168	277	0.57	0.40		1.42		
169	278	0.55	0.39		1.41		After sandblasting
170	279	0.55	0.43		1.27		

DATE OF MEASUREMENT: 1-59

TABLE 47. HOT ROLLED CONDITION BATTELLE MEMORIAL INST., Mg-14Li-1.5A1

CODE		γ	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
177	286	0.52	0.30		1.73		
178	287	0.52	0.32		1.62		Normal
179	288	0.61	0.32		1.90		
171	280	0.60	0.55		1.09		
172	281	0.62	0.53		1.16		After sandblasting
173	282	0.61	0.50		1.22		

DATE OF MEASUREMENT: 11-57

TABLE 48. METCO COATED ON STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
300	96	0.20	0.74	0.83	0.27	0.24	0.020" coating
300	48	0.20	0.79	0.74	0.25	0.27	0.020" coating, normal
	49		0.77				15°
	50		0.78				30°
	51		0.78				45°
	52		0.76				60°

GENERAL REMARKS: Nichrome V bond Plus Al_2O_3 (Metco 105 overcoat approx. 15 mils)

DATE OF MEASUREMENT: 7-57

TABLE 49. P-63 ON Cu PAINT (COATING)

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
9	98	0.24	0.81	0.91	0.30	0.26	
10	99	0.26	0.80	0.92	0.33	0.28	
11		0.25					

DATE OF MEASUREMENT: 4-58

TABLE 50. PAINT ON Cu (COATING)

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
97	128	0.25	0.91		0.27		
98	129	0.23	0.91		0.25		
99	130	0.31	0.95		0.33		
100	131	0.30	0.96		0.31		
101	132	0.16	0.87		0.18		
102	133	0.15	0.93		0.16		
103	134	0.21	0.95		0.22		
104	135	0.21	0.96		0.22		
105	136	0.23	0.92		0.25		
106	137	0.23	0.94		0.24		

DATE OF MEASUREMENT: 11-58

TABLE 51. PLASTIC DISCS

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
	197		0.83				
	198		0.88				
	199		0.90				
	200		0.91				
	201		0.90				
	202		0.91				

DATE OF MEASUREMENT: 11-57

TABLE 52. 0.080-INCH THICK FUSED QUARTZ

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
311	53	0.07	0.84	0.84			Normal
	54		0.88				15°
	55		0.85				30°
	56		0.87				45°
	57		0.88				60°

GENERAL REMARKS: Used as cover on solar cells.

DATE OF MEASUREMENT: 12-58

TABLE 53. ROKIDE ON 4130 STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
184	293	0.25	0.84		0.29		Rokide A (Al_2O_3)
185	294	0.30	0.81		0.37		
186	295	0.43	0.91		0.47		Rokide z (ZrO_2)
187	296	0.38	0.91		0.41		
188	297	0.39	0.91		0.42		Rokide zS ($ZrO_2 \cdot SiO_2$)
189	298	0.40	0.94		0.42		

GENERAL REMARKS: 20 mils

DATE OF MEASUREMENT: 8-59

TABLE 54. ROKIDE A COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENT
α	ϵ						
196	328	0.19	0.73	0.74	0.26	0.25	Clean
197	329	0.38	0.75	0.73	0.51	0.52	Oil
198	330	0.38	0.72	0.73	0.53	0.52	Oil
201	333	0.25	0.70	0.67	0.36	0.37	Pencil marked
202	334	0.26	0.70	0.68	0.37	0.38	Pencil marked
203	331	0.24	0.72	0.77	0.33	0.31	Fingerprint
204	332	0.25	0.69	0.72	0.36	0.34	Fingerprint

DATE OF MEASUREMENT: 7-57

TABLE 55. 0.010-INCH THICK ROKIDE A COATING ON 347 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
22	93	0.26	0.69	0.85	0.38	0.31	
23	94	0.23	0.69	0.83	0.33	0.28	

DATE OF MEASUREMENT: 11-57

TABLE 56. ROKIDE A COATING ON STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
298	1	0.17	0.81	0.79	0.20	0.21	0.020 coating
297	2	0.14	0.82	0.76	0.17	0.18	0.020 coating
299	3	0.24	0.80	0.82	0.30	0.29	0.010 coating

GENERAL REMARKS: α only measured from 0.4 to 0.7 micron

DATE OF MEASUREMENT: 8-59

TABLE 57. ROKIDE A, MAGNESIUM SUBSTRATE

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
203	306	0.16	0.74		0.21		{ Coated with 23 mills
204	307	0.16	0.74		0.21		Rokide A
205	308	0.21	0.78		0.26		{ Coated with 13 mills
206	309	0.21	0.79		0.26		Rokide A
209	312	0.22	0.77		0.28		10 mills Rokide A
210	313	0.16	0.73		0.21		20 mills Rokide A

DATE OF MEASUREMENT: 11-57

TABLE 58. ROKIDE A, 0.020-INCH THICK COATING ON STAINLESS STEEL,
SAMPLE 7

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
297	33	0.14	0.81	0.76	0.17	0.18	Normal
	34		0.79				15° Block
	35		0.78				30°
	36		0.80				45°
	37		0.79				60°

DATE OF MEASUREMENT: 11-57

TABLE 59. ROKIDE Z, COATING ON STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
295	6	0.39	0.89	0.87	0.43	0.44	0.010 coating
294	7	0.33	0.87	0.83	0.37	0.39	0.020 coating

GENERAL REMARKS: α only measured from 0.4 to 0.7 micron

DATE OF MEASUREMENT: 11-57

TABLE 60. ROKIDE Z, 0.010-INCH THICK COATING ON STAINLESS STEEL,
SAMPLE 11

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
295	43	0.39	0.88	0.87	0.43	0.44	Normal
	44		0.84				15° Block
	45		0.82				30°
	46		0.82				45°
	47		0.79				60°

DATE OF MEASUREMENT: 11-57

TABLE 61. ROKIDE ZS, COATED ON STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
293	4	0.30	0.94		0.31		0.020" coating
296	5	0.38	0.95	0.86	0.40	0.44	0.010" coating
	97		0.88	0.90			0.020" coating

GENERAL REMARKS: α only measured from 0.4 to 0.7 micron

DATE OF MEASUREMENT: 11-57

TABLE 62. ROKIDE ZS, 0.020-INCH THICK COATING ON STAINLESS STEEL,
SAMPLE 9

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
293	38	0.30	0.95		0.31		Normal
	39		0.96				15° Block
	40		0.94				30°
	41		0.94				45°
	42		0.91				60°

DATE OF MEASUREMENT: 5-60

TABLE 63. SILVER COATING ON MAGNESIUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
46		0.13	<0.03		>4.33		
47		0.13	<0.03		>4.33		
48		0.13	<0.03		>4.33		

GENERAL REMARKS: Sample prepared by MIT for coating their instrument package for the S-15 payload.

DATE OF MEASUREMENT: 4-58

TABLE 64. SOLAR CELL ASSEMBLY

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
64		0.87					Without quartz cover
29		0.86					With cover

GENERAL REMARKS: Reference [1]

TABLE 65. HOFFMAN SOLAR CELL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
312		0.88					Vanguard I Solar Power Supply

GENERAL REMARKS: Reference [1]

DATE OF MEASUREMENT: 11-57

TABLE 66. HOFFMAN SOLAR CELL (MOSAIC)

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
	107	0.86	0.43				

GENERAL REMARKS: Reference [1]

TABLE 67. INTERNATIONAL RECTIFIER MOSAIC SOLAR CELL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
313	396	0.92	0.37		2.49		

GENERAL REMARKS: Reference [1]

TABLE 68. HOFFMAN SILICON SOLAR CELL, MOSAIC SOLAR CELL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
292	395	0.86	0.37		2.32		

GENERAL REMARKS: Reference [1]

DATE OF MEASUREMENT: 8-58

TABLE 69. INTERNATIONAL RECTIFIER CORPORATION MOSAIC OF SILICON SOLAR CELL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
69		0.83					With quartz cover
70		0.86					Without quartz cover

GENERAL REMARKS: Reference [1]

DATE OF MEASUREMENT: 2-59

TABLE 70. INTERNATIONAL RECTIFIER CORPORATION AND SIGNAL CORPORATION SOLAR CELLS AT ROOM TEMPERATURE

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
286	393	0.92	0.36		2.56		
287	394	0.92	0.38		2.42		

GENERAL REMARKS: Reference [1]

DATE OF MEASUREMENT: 12-58

TABLE 71. SAUEREISEN SOLAR CELL MOUNTING MATERIAL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
288	299	0.35	0.88		0.40		

GENERAL REMARKS: Reference [1]

DATE OF MEASUREMENT: 7-58

TABLE 72. RCA SOLAR CELL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
	164		0.44				Cell A uncoated
	165		0.41				Cell B uncoated
	166		0.76				0.7U SiO coating
	167		0.80				0.7U SiO coating
	168		0.84				3U SiO coating
	169		0.85				3U SiO coating
	170		0.84				3U SiO coating
	171		0.85				5.4U SiO coating

GENERAL REMARKS: Reference [1]

DATE OF MEASUREMENT: 1-58

TABLE 73. 4 GM/MIN #2 S. S. WHITE, SANDBLASTED 430 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
40	29	0.51	0.16		3.19		No sandblast
30	25	0.55	0.21		2.62		15 sec.
31	26	0.57	0.22		2.59		30 sec.
32	27	0.59	0.23		2.57		1 min.
33	28	0.61	0.38		1.61		2 min.

GENERAL REMARKS: Satin finish treatment

DATE OF MEASUREMENT: 1-58

TABLE 74. 15 SEC, #2 S. S. WHITE, 4 GM/MIN SANDBLASTED 430 STAINLESS STEEL,
SAMPLE 5

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
30	73	0.55	0.21		2.62		Normal
	74		0.19				15° Block
	75		0.20				30°
	76		0.31				45°
	77		0.31				60°

GENERAL REMARKS: Satin finish treatment

DATE OF MEASUREMENT: 1-58

TABLE 75. 2 MIN. #2 S. S. WHITE, 4 GM/MIN SANDBLASTED 430 STAINLESS STEEL,
SAMPLE 8

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
33	78	0.61	0.38		1.61		Normal
	79		0.37				15° Block
	80		0.38				30°
	81		0.46				45°
	82		0.47				60°

GENERAL REMARKS: Satin finish treatment

DATE OF MEASUREMENT: 1-58

TABLE 76. #1 S. S. WHITE, 5 GM/MIN SANDBLASTED 430 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
40	29	0.51	0.16		3.19		No sandblast
36	21	0.57	0.33		1.73		15 sec.
37	22	0.60	0.34		1.76		30 sec.
38	23	0.65	0.38		1.71		1 min.
39	24	0.67	0.48		1.40		2 min.

GENERAL REMARKS: Satin finish treatment

DATE OF MEASUREMENT: 1-58

TABLE 77. 15 SEC, #1 S. S. WHITE, 5 GM/MIN SANDBLASTED 430 STAINLESS STEEL,
SAMPLE 1

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
36	63	0.57	0.33		1.73		Normal
	64		0.32				15° Block
	65		0.31				30° Block
	66		0.42				45° Block
	67		0.44				60° Block

GENERAL REMARKS: Satin finish treatment

DATE OF MEASUREMENT: 1-58

TABLE 78. 2 MIN., #1 S. S. WHITE, 5 GM/MIN SANDBLASTED 430 STAINLESS STEEL,
SAMPLE 4

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
41	68	0.67	0.48		1.4		Normal
	69		0.41				15° Block
	70		0.36				30°
	71		0.49				45°
	72		0.49				60°

GENERAL REMARKS: Satin finish treatment

DATE OF MEASUREMENT: 1-58

TABLE 79. 80 PSI 25G SANDBLASTED 430 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
40	29	0.51	0.16		3.19		No sandblast
34	31	0.58	0.30		1.93		15 sec.
35	32	0.59	0.31		1.90		30 sec.

DATE OF MEASUREMENT: 1-58

TABLE 80. 15 SEC 80 PSI 25G SANDBLASTED 430 STAINLESS STEEL, SAMPLE 1

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
34	83	0.58	0.30		1.93		Normal
	84		0.29				15° Block
	85		0.27				30°
	86		0.39				45°
	87		0.39				60°

DATE OF MEASUREMENT: 6-58

TABLE 81. SANDBLASTED 410 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
91	152	0.70	0.50		1.40		1 Pass
92	153	0.70	0.51		1.37		
93	154	0.74	0.51		1.45		2 Passes
94	155	0.75	0.50		1.50		
95	156	0.76	0.51		1.49		4 Passes
96	157	0.77	0.52		1.48		

DATE OF MEASUREMENT: 6-58

TABLE 82. SANDBLASTED 430 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
85	158	0.70	0.50		1.40		1 Pass
86	159	0.70	0.50		1.40		
87	160	0.66	0.52		1.26		2 Passes
88	161	0.66	0.50		1.32		
89	162	0.77	0.57		1.35		4 Passes
90	163	0.77	0.57		1.35		

GENERAL REMARKS: Satin finish treatment

DATE OF MEASUREMENT: 9-58

TABLE 82A. SANDBLASTED 430 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
83	383	0.68	0.44		1.54		Clean
84	384	0.68	0.43		1.58		
81	187	0.70	0.44		1.59		Fingerprints
82	187	0.74	0.44		1.68		

GENERAL REMARKS: Satin finish treatment

DATE OF MEASUREMENT: 9-58

TABLE 82B. SANDBLASTED 430 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
79	188	0.72	0.89		0.81		With liquid envelope
80	190	0.73	0.91		0.80		
65	189	0.69	0.43		1.60		Coating removed
66	191	0.69	0.43		1.60		

GENERAL REMARKS: Coating was BFC Liquid Envelope, transparent blue,
number 3253

DATE OF MEASUREMENT: 11-57

TABLE 83. 302 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
269	103	0.55	0.18		3.05		Polished
272	104	0.70	0.38	0.29	1.84	2.41	Sandblasted
273	105	0.72	0.47	0.42	1.53	1.71	3 Sandblasted
270		0.52					Light sandblast
271		0.69					2 Sandblast

GENERAL REMARKS: α only measured over range 0.4 to 0.7 micron

DATE OF MEASUREMENT: 7-57

TABLE 84. 347 STAINLESS STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
20	101	0.43	0.13		3.31		Polished
21	102	0.65	0.33	0.36	1.96	1.80	Sandblasted

DATE OF MEASUREMENT: 11-59

TABLE 85. TABOR

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
	381		0.39	0.34			

GENERAL REMARKS: Dark nickel over bright nickel prepared by Structures and Mechanics.

DATE OF MEASUREMENT: 9-59

TABLE 86. TABOR COATING

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
217	337	0.89	0.35	0.27	2.54	3.29	
218	338	0.91	0.33	0.29	2.76	3.13	

GENERAL REMARKS: Dark nickel over bright nickel prepared by Structures and Mechanics.

DATE OF MEASUREMENT: 3-60

TABLE 87. TABOR ON BRASS SUBSTRATE

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
56	120	0.89	0.64	0.45	1.39	1.97	Blank
58	118	0.85	0.33	0.31	2.58	2.74	Light
57	117	0.62	0.14	0.21	4.43	2.95	Medium
59	119	0.51	0.13	0.16	3.92	3.18	Heavy

GENERAL REMARKS: Dark nickel over bright nickel prepared by Structures and Mechanics and given satin finish with nozzle at 4, 2, and 1 inches.

DATE OF MEASUREMENT: 11-60

TABLE 88. TABOR-TYPE SURFACE

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
	425		0.025	0.16			2 minutes
	426		0.035	0.17			
	427		0.057	0.16			5 minutes
	428		0.092	0.14			
	429		0.174	0.23			10 minutes
	430		0.171	0.25			
	431		0.61	0.60			20 minutes
	432		0.61	0.56			
	433		0.79	0.64			30 minutes
	434		0.80	0.70			

GENERAL REMARKS: Prepared by Structures and Mechanics, dark nickel over bright nickel over aluminum, varying the time in the dark nickel solution.

DATE OF MEASUREMENT: 3-60

TABLE 89. TIN COATING ON MAGNESIUM

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
49	114	0.25	0.30	0.08	0.83	3.12	Plate 1
50	115	0.25	0.29	0.10	0.86	2.50	Plate 2
51	116	0.27	0.30	0.10	0.90	2.70	Plate 3

GENERAL REMARKS: Sample prepared by MIT for coating their instrument package for the S-15 payload.

DATE OF MEASUREMENT: 12-58

TABLE 90. THERMOSPRAY 105 COATING ON 4130 STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
180	289	0.28	0.81		0.34		
181	290	0.27	0.81		0.33		

GENERAL REMARKS: White aluminum oxide applied with power gun.

DATE OF MEASUREMENT: 12-58

TABLE 91. THERMOSPRAY 201 COATING ON 4130 STEEL

CODE		α	ϵ_I	ϵ_T	α/ϵ_I	α/ϵ_T	COMMENTS
α	ϵ						
182	291	0.30	0.88		0.34		
183	292	0.30	0.90		0.33		

GENERAL REMARKS: Zirconia applied with powder gun.

DATA SECTION III
HEMISPHERICAL SPECTRAL REFLECTANCE

TABLE 92. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 1 THROUGH 15

λ (μ) \ CODE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.4	0.46	0.45	0.46	0.44	0.44	0.45	0.80	0.33	0.71	0.68	0.70	0.36	0.36	0.82	0.11
0.45	0.47	0.46	0.46	0.45	0.45	0.45	0.82	0.32	0.87	0.83	0.85	0.91	0.89	0.92	0.12
0.5	0.47	0.46	0.47	0.45	0.45	0.45	0.83	0.31	0.88	0.85	0.87	0.93	0.92	0.93	0.14
0.55	0.47	0.46	0.47	0.45	0.45	0.45	0.83	0.30	0.87	0.85	0.86	0.94	0.93	0.93	0.14
0.6	0.47	0.46	0.47	0.45	0.45	0.46	0.83	0.30	0.86	0.84	0.85	0.94	0.94	0.93	0.15
0.65	0.47	0.46	0.47	0.45	0.46	0.46	0.83	0.29	0.85	0.84	0.84	0.94	0.94	0.93	0.16
0.7	0.47	0.46	0.47	0.45	0.46	0.46	0.82	0.28	0.84	0.83	0.83	0.95	0.95	0.92	0.16
1.0	0.43	0.40	0.36	0.36	0.40	0.36	0.73	0.73	0.76	0.74	0.74	0.83	0.84	0.82	0.15
1.5	0.58	0.55	0.58	0.58	0.58	0.58	0.90	0.90	0.59	0.60	0.58	0.71	0.68	0.73	0.21
2.0	0.58	0.55	0.55	0.55	0.58	0.55	0.93	0.90	0.52	0.50	0.55	0.65	0.66	0.68	0.19
2.5	0.62	0.62	0.62	0.62	0.62	0.58	0.92	0.90	0.40	0.43	0.43	0.55	0.50	0.61	0.23
3.0	0.72	0.68	0.72	0.72	0.72	0.72	0.82	0.81	0.37	0.40	0.37	0.33	0.33	0.33	0.28
3.5	0.67	0.67	0.67	0.67	0.71	0.67	0.91	0.86	0.34	0.34	0.30	0.55	0.59	0.53	0.24

TABLE 93. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 16 THROUGH 30

λ (μ) \ CODE	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
0.4	0.11	0.10	0.70	0.50	0.47	0.31	0.76	0.77	0.82	0.75	0.75	0.80	0.76	0.14	0.40	
0.45	0.12	0.12	0.70	0.51	0.51	0.32	0.80	0.81	0.91	0.82	0.82	0.82	0.78	0.13	0.41	
0.5	0.14	0.13	0.70	0.52	0.53	0.33	0.80	0.83	0.93	0.84	0.84	0.84	0.83	0.80	0.12	0.42
0.55	0.14	0.13	0.70	0.52	0.55	0.34	0.79	0.82	0.93	0.86	0.86	0.86	0.83	0.81	0.12	0.42
0.6	0.16	0.14	0.69	0.52	0.57	0.35	0.79	0.82	0.93	0.86	0.86	0.87	0.83	0.81	0.11	0.43
0.65	0.16	0.15	0.69	0.51	0.58	0.35	0.78	0.81	0.93	0.86	0.86	0.87	0.83	0.80	0.11	0.43
0.7	0.16	0.16	0.68	0.51	0.59	0.36	0.78	0.81	0.92	0.85	0.85	0.87	0.82	0.80	0.10	0.44
1.0	0.15	0.11	0.67	0.50	0.58	0.35	0.70	0.73	0.83	0.77	0.78	0.78	0.73	0.73	0.21	0.42
1.5	0.18	0.18	0.84	0.61	0.66	0.38	0.66	0.69	0.73	0.69	0.69	0.69	0.90	0.90	0.15	0.56
2.0	0.19	0.18	0.82	0.58	0.69	0.36	0.56	0.58	0.72	0.67	0.70	0.93	0.90	0.20	0.61	
2.5	0.23	0.21	0.88	0.65	0.72	0.43	0.61	0.61	0.58	0.48	0.51	0.92	0.90	0.18	0.54	
3.0	0.28	0.26	0.84	0.58	0.68	0.46	0.54	0.67	0.40	0.28	0.28	0.82	0.81	0.14	0.63	
3.5	0.26	0.26	0.81	0.59	0.69	0.53	0.62	0.70	0.48	0.45	0.43	0.91	0.86	0.14	0.64	

TABLE 94. HEMISPHERICAL SPECTRAL REFLECTANCE OF CODE 31 THROUGH 45

$\lambda (\mu)$	CODE 31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
0.4	0.39	0.38	0.37	0.34	0.34	0.38	0.35	0.31	0.30	0.42	0.39	0.47	0.47	0.43	0.43
0.45	0.40	0.39	0.38	0.36	0.36	0.39	0.37	0.32	0.31	0.44	0.41	0.48	0.48	0.44	0.44
0.5	0.41	0.40	0.39	0.38	0.38	0.40	0.38	0.33	0.32	0.45	0.42	0.48	0.48	0.44	0.44
0.55	0.41	0.40	0.39	0.39	0.39	0.41	0.38	0.33	0.32	0.46	0.43	0.48	0.48	0.44	0.44
0.6	0.42	0.40	0.39	0.40	0.40	0.41	0.38	0.33	0.32	0.47	0.44	0.48	0.48	0.44	0.44
0.65	0.42	0.41	0.40	0.41	0.41	0.41	0.39	0.33	0.32	0.47	0.44	0.48	0.48	0.44	0.44
0.7	0.43	0.41	0.40	0.42	0.42	0.42	0.39	0.34	0.33	0.48	0.45	0.48	0.47	0.44	0.44
1.0	0.40	0.36	0.34	0.42	0.42	0.42	0.38	0.36	0.34	0.46	0.46	0.45	0.45	0.43	0.43
1.5	0.53	0.49	0.46	0.53	0.51	0.54	0.49	0.46	0.40	0.61	0.59	0.54	0.54	0.52	0.52
2.0	0.56	0.52	0.47	0.54	0.49	0.56	0.50	0.45	0.43	0.63	0.63	0.53	0.53	0.50	0.50
2.5	0.51	0.49	0.45	0.55	0.53	0.59	0.50	0.44	0.39	0.67	0.65	0.58	0.58	0.53	0.53
3.0	0.56	0.54	0.46	0.59	0.56	0.55	0.49	0.50	0.43	0.66	0.66	0.57	0.57	0.53	0.53
3.5	0.53	0.57	0.42	0.53	0.57	0.57	0.48	0.39	0.34	0.70	0.66	0.54	0.54	0.50	0.50

TABLE 95. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 46 THROUGH 60

λ (μ)	CODE	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
0.4	0.71	0.76	0.73	0.65	0.63	0.61	0.29	0.31	0.30	0.28	0.09	0.27	0.12	0.37	0.24	
0.45	0.77	0.82	0.82	0.71	0.70	0.68	0.29	0.32	0.30	0.28	0.09	0.31	0.13	0.41	0.30	
0.5	0.82	0.86	0.87	0.76	0.75	0.73	0.37	0.41	0.39	0.36	0.10	0.34	0.14	0.45	0.13	
0.55	0.90	0.88	0.90	0.78	0.77	0.75	0.67	0.74	0.68	0.66	0.10	0.37	0.15	0.48	0.44	
0.6	0.92	0.89	0.92	0.78	0.78	0.76	0.79	0.85	0.80	0.80	0.10	0.39	0.15	0.50	0.33	
0.65	0.94	0.90	0.92	0.78	0.78	0.76	0.85	0.89	0.85	0.86	0.10	0.40	0.16	0.52	0.29	
0.7	0.95	0.91	0.93	0.78	0.78	0.76	0.87	0.91	0.88	0.89	0.11	0.42	0.16	0.53	0.25	
1.0	0.85	0.85	0.84	0.68	0.72	0.68	0.84	0.84	0.84	0.84	0.13	0.36	0.16	0.48	0.44	
1.5	0.93	0.90	0.90	0.83	0.83	0.83	0.90	0.92	0.87	0.90	0.12	0.49	0.20	0.62	0.72	
2.0	0.98	0.98	0.98	0.87	0.84	0.87	0.90	0.92	0.89	0.90	0.16	0.55	0.24	0.68	0.84	
2.5	0.97	0.94	0.93	0.90	0.87	0.90	0.90	0.92	0.90	0.90	0.12	0.52	0.16	0.66	0.81	
3.0	0.98	0.98	0.98	0.93	0.97	0.93	0.92	0.92	0.90	0.92	0.17	0.57	0.21	0.72	0.78	
3.5	0.98	0.98	0.98	0.93	0.93	0.88	0.92	0.92	0.90	0.92	0.14	0.54	0.14	0.63	0.67	

TABLE 96. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 61 THROUGH 75

λ (μ) \ CODE	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
0.4	0.25	0.37	0.26	0.09	0.28	0.28	0.60	0.59	0.17	0.13	0.13	0.09	0.10		
0.45	0.46	0.44	0.07	0.07	0.28	0.30	0.63	0.61	0.17	0.13	0.14	0.10	0.11		
0.5	0.06	0.31	0.22	0.06	0.29	0.30	0.65	0.63	0.18	0.14	0.15	0.11	0.11		
0.55	0.39	0.50	0.28	0.06	0.30	0.30	0.66	0.64	0.18	0.15	0.16	0.12	0.12		
0.6	0.32	0.43	0.23	0.05	0.30	0.30	0.67	0.65	0.18	0.15	0.16	0.13	0.13		
0.65	0.29	0.41	0.04	0.05	0.30	0.30	0.68	0.65	0.18	0.15	0.17	0.14	0.14		
0.7	0.13	0.38	0.72	0.05	0.30	0.31	0.68	0.65	0.18	0.15	0.18	0.15	0.15		
1.0	0.48	0.48	0.56	0.19	0.30	0.31	0.52	0.55	0.15	0.12	0.19	0.13	0.13	0.15	0.15
1.5	0.78	0.72	0.84	0.26	0.42	0.40	0.73	0.73	0.17	0.16	0.21	0.18	0.16	0.21	0.18
2.0	0.90	0.81	0.96	0.22	0.34	0.36	0.66	0.66	0.21	0.17	0.19	0.18	0.18	0.19	0.19
2.5	0.87	0.72	0.99	0.18	0.39	0.38	0.64	0.67	0.18	0.17	0.21	0.16	0.16	0.23	0.23
3.0	0.83	0.78	0.93	0.14	0.43	0.43	0.69	0.69	0.14	0.16	0.28	0.26	0.26	0.28	0.28
3.5	0.71	0.71	0.74	0.16	0.41	0.39	0.64	0.65	0.17	0.14	0.28	0.24	0.24	0.26	0.26

TABLE 97. HEMISPHERICAL SPECTRAL REFLECTANCE & CODE 76 THROUGH 90

λ (μ) \ CODE	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
0.4	0.26	0.26	0.25	0.25	0.24	0.21	0.29	0.28	0.26	0.26	0.35	0.35	0.20	0.20	0.20
0.45	0.30	0.30	0.25	0.25	0.30	0.23	0.30	0.30	0.27	0.27	0.36	0.36	0.21	0.21	0.21
0.5	0.33	0.33	0.25	0.25	0.31	0.24	0.30	0.30	0.27	0.27	0.36	0.36	0.22	0.22	0.22
0.55	0.35	0.35	0.25	0.24	0.32	0.24	0.30	0.30	0.28	0.28	0.36	0.36	0.22	0.22	0.22
0.6	0.37	0.38	0.25	0.25	0.32	0.25	0.31	0.30	0.28	0.28	0.36	0.36	0.22	0.22	0.22
0.65	0.38	0.39	0.27	0.26	0.33	0.25	0.31	0.31	0.28	0.28	0.37	0.37	0.23	0.23	0.23
0.7	0.39	0.39	0.28	0.27	0.33	0.25	0.32	0.31	0.28	0.28	0.37	0.37	0.23	0.23	0.23
1.0	0.11	0.31	0.29	0.31	0.24	0.24	0.30	0.31	0.33	0.33	0.28	0.28	0.21	0.21	0.21
1.5	0.18	0.49	0.49	0.35	0.33	0.37	0.35	0.38	0.39	0.37	0.34	0.31	0.28	0.28	0.28
2.0	0.18	0.36	0.38	0.33	0.32	0.36	0.36	0.37	0.36	0.37	0.37	0.34	0.30	0.25	0.25
2.5	0.21	0.39	0.39	0.29	0.30	0.39	0.37	0.41	0.41	0.38	0.38	0.33	0.33	0.25	0.25
3.0	0.26	0.45	0.41	0.31	0.31	0.38	0.38	0.41	0.41	0.33	0.37	0.37	0.33	0.33	0.33
3.5	0.26	0.44	0.50	0.25	0.27	0.44	0.36	0.37	0.37	0.44	0.44	0.40	0.44	0.28	0.25

TABLE 98. HEMISPHERICAL SPECTRAL REFLECTANCE & CODE 91 THROUGH 105

λ (μ) \ CODE	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105
0.4	0.26	0.26	0.22	0.22	0.21	0.21	0.35	0.35	0.38	0.38	0.80	0.80	0.75	0.75	0.78
0.45	0.27	0.27	0.23	0.23	0.21	0.88	0.88	0.76	0.76	0.90	0.90	0.83	0.83	0.89	
0.5	0.28	0.28	0.23	0.23	0.23	0.22	0.90	0.91	0.81	0.81	0.92	0.92	0.86	0.86	0.91
0.55	0.28	0.28	0.23	0.23	0.23	0.22	0.91	0.93	0.83	0.83	0.92	0.93	0.86	0.86	0.92
0.6	0.28	0.28	0.24	0.24	0.23	0.22	0.91	0.93	0.83	0.84	0.92	0.93	0.87	0.87	0.91
0.65	0.28	0.28	0.24	0.24	0.23	0.22	0.91	0.93	0.83	0.84	0.92	0.93	0.87	0.87	0.86
0.7	0.29	0.29	0.24	0.24	0.23	0.22	0.90	0.93	0.82	0.84	0.91	0.93	0.87	0.87	0.87
1.0	0.30	0.30	0.28	0.25	0.21	0.21	0.77	0.85	0.73	0.77	0.80	0.83	0.77	0.77	0.78
1.5	0.37	0.37	0.31	0.31	0.31	0.31	0.74	0.74	0.67	0.64	0.76	0.79	0.72	0.70	0.67
2.0	0.33	0.37	0.32	0.29	0.30	0.30	0.70	0.71	0.65	0.65	0.72	0.74	0.74	0.72	0.67
2.5	0.41	0.41	0.33	0.35	0.30	0.30	0.53	0.53	0.48	0.46	0.61	0.58	0.54	0.54	0.51
3.0	0.35	0.35	0.28	0.28	0.24	0.24	0.41	0.41	0.37	0.35	0.28	0.45	0.41	0.37	0.35
3.5	0.34	0.32	0.37	0.37	0.32	0.29	0.48	0.46	0.50	0.39	0.53	0.50	0.43	0.43	0.43

TABLE 99. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 106 THROUGH 120

λ (μ) \ CODE	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
0.4	0.78	0.06	0.06	0.19	0.18	0.11	0.12	0.53	0.65	0.26	0.23	0.75	0.65	0.13	0.17
0.45	0.89	0.06	0.06	0.23	0.33	0.14	0.15	0.66	0.74	0.30	0.27	0.80	0.73	0.15	0.18
0.5	0.91	0.06	0.06	0.30	0.30	0.19	0.20	0.75	0.79	0.34	0.31	0.83	0.78	0.16	0.19
0.55	0.92	0.06	0.06	0.32	0.31	0.17	0.19	0.80	0.82	0.36	0.34	0.85	0.81	0.17	0.19
0.6	0.92	0.07	0.07	0.30	0.29	0.16	0.17	0.83	0.83	0.39	0.36	0.85	0.82	0.18	0.21
0.65	0.86	0.12	0.11	0.33	0.33	0.19	0.20	0.84	0.84	0.40	0.38	0.86	0.84	0.19	0.22
0.7	0.67	0.17	0.15	0.37	0.37	0.22	0.24	0.86	0.85	0.41	0.38	0.86	0.84	0.20	0.22
1.0	0.78	0.35	0.33	0.41	0.39	0.25	0.25	0.77	0.77	0.39	0.33	0.77	0.76	0.19	0.19
1.5	0.65	0.40	0.38	0.38	0.19	0.19	0.78	0.80	0.49	0.46	0.82	0.82	0.29	0.29	
2.0	0.67	0.30	0.30	0.38	0.38	0.20	0.20	0.72	0.72	0.38	0.35	0.72	0.76	0.19	0.19
2.5	0.51	0.20	0.20	0.23	0.23	0.10	0.16	0.78	0.77	0.43	0.41	0.77	0.77	0.27	0.22
3.0	0.35	0.14	0.19	0.14	0.14	0.11	0.11	0.78	0.78	0.41	0.41	0.78	0.78	0.25	0.25
3.5	0.46	0.20	0.16	0.29	0.20	0.16	0.13	0.85	0.85	0.39	0.34	0.85	0.85	0.25	0.25

TABLE 100. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 121 THROUGH 135

λ (μ)	CODE	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
0.4	0.16	0.10	0.10	0.13	0.11	0.13	0.11	0.27	0.27	0.26	0.11	0.11	0.11	0.28	0.31	
0.45	0.17	0.11	0.11	0.13	0.12	0.13	0.12	0.27	0.27	0.26	0.11	0.11	0.11	0.29	0.31	
0.5	0.18	0.11	0.11	0.13	0.12	0.14	0.12	0.32	0.32	0.32	0.14	0.15	0.14	0.35	0.38	
0.55	0.20	0.12	0.12	0.14	0.12	0.14	0.12	0.54	0.55	0.54	0.21	0.21	0.20	0.61	0.67	
0.6	0.20	0.12	0.12	0.14	0.13	0.15	0.13	0.65	0.66	0.65	0.14	0.14	0.14	0.71	0.78	
0.65	0.21	0.12	0.12	0.14	0.13	0.15	0.14	0.72	0.73	0.72	0.16	0.17	0.16	0.75	0.82	
0.7	0.21	0.13	0.13	0.15	0.13	0.15	0.14	0.78	0.78	0.78	0.21	0.21	0.20	0.77	0.84	
1.0	0.17	0.13	0.11	0.13	0.11	0.09	0.09	0.92	0.93	0.93	0.30	0.30	0.28	0.84	0.90	
1.5	0.24	0.18	0.18	0.18	0.16	0.13	0.14	0.89	0.89	0.89	0.26	0.26	0.24	0.86	0.87	
2.0	0.18	0.13	0.10	0.10	0.13	0.10	0.10	0.91	0.91	0.91	0.26	0.26	0.26	0.88	0.90	
2.5	0.18	0.16	0.18	0.16	0.13	0.13	0.13	0.89	0.89	0.89	0.26	0.26	0.24	0.86	0.87	
3.0	0.28	0.26	0.26	0.23	0.14	0.14	0.19	0.90	0.90	0.90	0.29	0.29	0.26	0.89	0.89	
3.5	0.25	0.24	0.20	0.20	0.17	0.20	0.91	0.91	0.91	0.30	0.31	0.31	0.91	0.91	0.91	

TABLE 101. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 136 THROUGH 150

λ (μ) \ CODE	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150
0.4	0.27	0.30	0.56	0.56	0.53	0.53	0.48	0.49	0.58	0.59	0.56	0.55	0.50	0.51	0.58
0.45	0.27	0.30	0.57	0.56	0.54	0.54	0.49	0.49	0.59	0.60	0.56	0.56	0.50	0.51	0.58
0.5	0.33	0.36	0.57	0.57	0.54	0.54	0.49	0.49	0.60	0.60	0.57	0.56	0.51	0.51	0.59
0.55	0.60	0.64	0.58	0.57	0.54	0.54	0.50	0.50	0.60	0.61	0.57	0.57	0.51	0.51	0.59
0.6	0.68	0.73	0.58	0.57	0.54	0.54	0.49	0.50	0.60	0.61	0.57	0.56	0.51	0.51	0.59
0.65	0.72	0.78	0.57	0.57	0.54	0.54	0.49	0.49	0.60	0.61	0.57	0.56	0.51	0.51	0.59
0.7	0.74	0.80	0.57	0.56	0.53	0.53	0.49	0.49	0.59	0.60	0.56	0.56	0.50	0.50	0.58
1.0	0.83	0.90	0.60	0.62	0.57	0.56	0.54	0.53	0.65	0.64	0.58	0.58	0.54	0.54	0.61
1.5	0.86	0.86	0.74	0.74	0.67	0.67	0.65	0.65	0.74	0.74	0.70	0.72	0.65	0.65	0.76
2.0	0.89	0.90	0.76	0.76	0.75	0.73	0.69	0.67	0.78	0.80	0.74	0.74	0.68	0.68	0.78
2.5	0.88	0.88	0.77	0.77	0.74	0.74	0.67	0.67	0.80	0.80	0.73	0.74	0.71	0.71	0.78
3.0	0.89	0.86	0.78	0.78	0.72	0.73	0.68	0.66	0.78	0.78	0.76	0.76	0.66	0.66	0.76
3.5	0.91	0.91	0.70	0.71	0.69	0.69	0.68	0.67	0.73	0.73	0.70	0.70	0.68	0.68	0.71

TABLE 102. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 151 THROUGH 165

λ (μ) \ CODE	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
0.4	0.57	0.54	0.54	0.51	0.49	0.49	0.67	0.57	0.51	0.54	0.53	0.53	0.75	0.75	0.75
0.45	0.58	0.54	0.55	0.52	0.52	0.50	0.50	0.70	0.58	0.52	0.54	0.53	0.54	0.77	0.77
0.5	0.59	0.55	0.55	0.52	0.52	0.50	0.50	0.73	0.60	0.52	0.55	0.53	0.54	0.80	0.80
0.55	0.59	0.55	0.55	0.52	0.52	0.50	0.50	0.75	0.61	0.52	0.55	0.53	0.54	0.81	0.81
0.6	0.59	0.55	0.55	0.52	0.52	0.50	0.50	0.76	0.61	0.52	0.55	0.53	0.54	0.81	0.81
0.65	0.58	0.55	0.55	0.52	0.52	0.50	0.49	0.76	0.61	0.52	0.54	0.53	0.54	0.81	0.81
0.7	0.58	0.54	0.54	0.51	0.51	0.49	0.49	0.76	0.61	0.52	0.54	0.52	0.53	0.81	0.80
1.0	0.61	0.58	0.56	0.56	0.54	0.45	0.43	0.70	0.60	0.48	0.48	0.48	0.47	0.87	0.85
1.5	0.74	0.72	0.72	0.66	0.64	0.57	0.57	0.83	0.77	0.63	0.64	0.61	0.61	0.90	0.91
2.0	0.78	0.74	0.74	0.72	0.72	0.61	0.61	0.88	0.83	0.66	0.67	0.63	0.63	0.97	0.97
2.5	0.78	0.75	0.75	0.72	0.72	0.57	0.58	0.83	0.78	0.62	0.63	0.60	0.60	0.93	0.92
3.0	0.76	0.73	0.73	0.72	0.73	0.62	0.62	0.86	0.82	0.68	0.72	0.64	0.66	0.84	0.83
3.5	0.71	0.70	0.70	0.69	0.69	0.64	0.59	0.84	0.80	0.69	0.64	0.64	0.64	0.83	0.83

TABLE 103. HEMISPHERICAL SPECTRAL REFLECTANCE & CODE 166 THROUGH 180

λ (μ) \ CODE	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	
λ (μ)																
0.4	0.75	0.81	0.38	0.40	0.40	0.36	0.32	0.35	0.48	0.50	0.48	0.36	0.37	0.29	0.77	
0.45	0.77	0.83	0.40	0.42	0.42	0.39	0.35	0.37	0.53	0.54	0.52	0.41	0.42	0.32	0.78	
0.5	0.79	0.84	0.41	0.43	0.44	0.41	0.37	0.39	0.57	0.57	0.55	0.44	0.45	0.35	0.77	
0.55	0.81	0.85	0.42	0.44	0.45	0.42	0.38	0.40	0.59	0.59	0.57	0.47	0.48	0.37	0.77	
0.6	0.81	0.84	0.42	0.44	0.45	0.42	0.38	0.41	0.61	0.60	0.59	0.49	0.50	0.39	0.76	
0.65	0.81	0.84	0.43	0.45	0.45	0.46	0.43	0.39	0.41	0.61	0.60	0.60	0.51	0.52	0.41	0.75
0.7	0.80	0.83	0.43	0.45	0.46	0.43	0.39	0.41	0.62	0.62	0.61	0.61	0.52	0.53	0.42	0.74
1.0	0.84	0.87	0.46	0.46	0.46	0.40	0.42	0.40	0.59	0.59	0.57	0.59	0.49	0.49	0.40	0.70
1.5	0.91	0.92	0.47	0.49	0.49	0.40	0.40	0.36	0.64	0.64	0.66	0.66	0.56	0.54	0.48	0.60
2.0	0.97	0.97	0.44	0.44	0.47	0.33	0.33	0.31	0.60	0.57	0.60	0.51	0.51	0.46	0.60	
2.5	0.92	0.91	0.47	0.49	0.49	0.38	0.38	0.36	0.65	0.62	0.65	0.54	0.54	0.52	0.56	
3.0	0.89	0.86	0.52	0.52	0.59	0.46	0.48	0.48	0.66	0.66	0.70	0.63	0.63	0.54	0.50	
3.5	0.85	0.85	0.60	0.60	0.65	0.46	0.46	0.46	0.74	0.68	0.74	0.62	0.62	0.49	0.59	

TABLE 104. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 181 THROUGH 195

λ (μ) \ CODE	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195
0.4	0.78	0.44	0.44	0.76	0.73	0.39	0.41	0.47	0.48	0.33	0.18	0.62	0.50	0.40	0.22
0.45	0.79	0.63	0.63	0.80	0.74	0.52	0.57	0.60	0.59	0.33	0.19	0.65	0.53	0.41	0.22
0.5	0.78	0.72	0.72	0.81	0.74	0.59	0.65	0.67	0.65	0.41	0.24	0.64	0.53	0.43	0.22
0.55	0.78	0.78	0.78	0.81	0.74	0.63	0.70	0.69	0.67	0.72	0.43	0.63	0.52	0.43	0.22
0.6	0.77	0.80	0.80	0.80	0.73	0.64	0.72	0.69	0.67	0.82	0.52	0.63	0.51	0.44	0.22
0.65	0.76	0.80	0.80	0.80	0.73	0.64	0.71	0.68	0.66	0.85	0.57	0.62	0.51	0.44	0.22
0.7	0.75	0.80	0.80	0.80	0.72	0.64	0.71	0.67	0.66	0.88	0.60	0.62	0.52	0.45	0.23
1.0	0.70	0.75	0.76	0.74	0.71	0.62	0.67	0.65	0.63	0.98	0.78	0.73	0.63	0.56	0.33
1.5	0.61	0.73	0.73	0.64	0.61	0.60	0.61	0.57	0.56	0.97	0.78	0.72	0.63	0.78	0.53
2.0	0.61	0.75	0.74	0.60	0.58	0.60	0.61	0.59	0.59	0.98	0.82	0.74	0.67	0.82	0.56
2.5	0.57	0.68	0.68	0.59	0.55	0.57	0.57	0.54	0.54	0.94	0.78	0.74	0.67	0.80	0.56
3.0	0.50	0.64	0.64	0.51	0.51	0.52	0.52	0.45	0.47	0.97	0.82	0.82	0.74	0.87	0.64
3.5	0.61	0.67	0.67	0.67	0.67	0.59	0.59	0.54	0.54	0.95	0.83	0.79	0.76	0.79	0.65

TABLE 105. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 196 THROUGH 210

λ (μ) \ CODE	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210
λ (μ)															
0.4	0.84	0.55	0.55	0.77	0.63	0.76	0.76	0.84	0.85	0.83	0.82	0.41	0.42	0.82	0.85
0.45	0.88	0.62	0.65	0.81	0.69	0.79	0.79	0.91	0.91	0.87	0.85	0.42	0.43	0.85	0.91
0.5	0.88	0.64	0.67	0.81	0.71	0.79	0.79	0.92	0.92	0.86	0.85	0.42	0.44	0.84	0.92
0.55	0.87	0.64	0.67	0.81	0.71	0.78	0.78	0.91	0.91	0.85	0.84	0.43	0.44	0.83	0.91
0.6	0.86	0.64	0.67	0.81	0.72	0.77	0.77	0.91	0.91	0.84	0.83	0.44	0.45	0.82	0.90
0.65	0.86	0.64	0.67	0.81	0.73	0.77	0.77	0.91	0.91	0.84	0.83	0.44	0.46	0.82	0.90
0.7	0.85	0.64	0.67	0.80	0.73	0.76	0.77	0.90	0.91	0.83	0.83	0.45	0.47	0.82	0.90
1.0	0.83	0.69	0.67	0.79	0.76	0.81	0.75	0.84	0.84	0.82	0.82	0.43	0.42	0.80	0.86
1.5	0.65	0.58	0.57	0.63	0.63	0.64	0.62	0.65	0.65	0.60	0.60	0.40	0.40	0.60	0.63
2.0	0.59	0.51	0.51	0.57	0.56	0.58	0.56	0.58	0.60	0.57	0.56	0.38	0.38	0.54	0.56
2.5	0.68	0.57	0.55	0.63	0.60	0.63	0.60	0.65	0.66	0.65	0.65	0.50	0.51	0.63	0.65
3.0	0.53	0.40	0.37	0.49	0.46	0.53	0.50	0.61	0.61	0.57	0.57	0.45	0.48	0.57	0.57
3.5	0.54	0.43	0.39	0.48	0.48	0.54	0.52	0.52	0.46	0.46	0.46	0.46	0.48	0.48	0.48

TABLE 106. HEMISPHERICAL SPECTRAL REFLECTANCE & CODE 211 THROUGH 225

λ (μ) \ CODE	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225
0.4	0.38	0.37	0.28	0.27	0.22	0.23	0.08	0.06	0.30	0.30	0.31	0.45	0.46	0.44	
0.45	0.56	0.55	0.34	0.34	0.25	0.25	0.08	0.08	0.59	0.59	0.59	0.84	0.85	0.84	
0.5	0.54	0.54	0.33	0.33	0.23	0.24	0.09	0.09	0.66	0.66	0.67	0.67	0.87	0.88	0.86
0.55	0.53	0.52	0.32	0.32	0.22	0.22	0.09	0.09	0.70	0.70	0.71	0.72	0.89	0.90	0.88
0.6	0.52	0.51	0.31	0.31	0.21	0.21	0.09	0.08	0.71	0.71	0.73	0.75	0.91	0.91	0.90
0.65	0.50	0.50	0.30	0.30	0.20	0.20	0.09	0.07	0.71	0.71	0.74	0.76	0.92	0.92	0.91
0.7	0.49	0.49	0.28	0.29	0.20	0.20	0.10	0.07	0.71	0.71	0.74	0.76	0.93	0.92	0.92
1.0	0.44	0.44	0.31	0.31	0.24	0.23	0.11	0.11	0.69	0.69	0.69	0.71	0.91	0.91	0.89
1.5	0.34	0.34	0.21	0.21	0.11	0.11	0.21	0.10	0.50	0.50	0.54	0.57	0.65	0.65	0.65
2.0	0.29	0.29	0.21	0.21	0.10	0.10	0.19	0.08	0.46	0.46	0.47	0.49	0.53	0.53	0.51
2.5	0.25	0.25	0.21	0.21	0.10	0.10	0.25	0.16	0.37	0.37	0.41	0.43	0.41	0.41	0.40
3.0	0.23	0.25	0.21	0.21	0.20	0.16	0.25	0.25	0.25	0.25	0.25	0.26	0.23	0.23	0.23
3.5	0.11	0.11	0.11	0.11	0.11	0.11	0.15	0.11	0.26	0.22	0.17	0.22	0.15	0.15	0.15

TABLE I²⁷. HEMISPHERICAL SPECTRAL REFLECTANCE & CODE 226 THROUGH 240

TABLE 108. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 241 THROUGH 255

λ (μ) \ CODE	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
λ (μ)															
0.4	0.37	0.37	0.06	0.06	0.06	0.06	0.25	0.25	0.21	0.20	0.12	0.13	0.09	0.09	0.13
0.45	0.84	0.84	0.06	0.06	0.06	0.06	0.28	0.28	0.21	0.21	0.12	0.12	0.09	0.09	0.07
0.5	0.87	0.87	0.06	0.06	0.06	0.06	0.27	0.27	0.20	0.20	0.11	0.12	0.08	0.08	0.10
0.55	0.88	0.88	0.07	0.07	0.07	0.07	0.29	0.29	0.21	0.21	0.12	0.13	0.09	0.09	0.17
0.6	0.89	0.89	0.21	0.21	0.19	0.20	0.54	0.54	0.45	0.45	0.32	0.33	0.26	0.26	0.09
0.65	0.89	0.89	0.26	0.26	0.23	0.24	0.61	0.61	0.52	0.51	0.39	0.40	0.32	0.32	0.12
0.7	0.89	0.89	0.33	0.32	0.30	0.30	0.68	0.69	0.59	0.58	0.48	0.48	0.40	0.40	0.20
1.0	0.88	0.88	0.37	0.37	0.34	0.34	0.69	0.69	0.63	0.63	0.53	0.53	0.43	0.44	0.55
1.5	0.55	0.55	0.44	0.44	0.53	0.53	0.63	0.63	0.55	0.55	0.57	0.57	0.60	0.60	0.45
2.0	0.38	0.38	0.41	0.44	0.49	0.50	0.53	0.53	0.46	0.47	0.49	0.51	0.53	0.54	0.42
2.5	0.34	0.34	0.40	0.45	0.48	0.50	0.45	0.48	0.48	0.48	0.50	0.50	0.55	0.55	0.42
3.0	0.23	0.23	0.26	0.28	0.36	0.36	0.25	0.25	0.27	0.27	0.33	0.30	0.36	0.34	0.25
3.5	0.17	0.17	0.17	0.22	0.17	0.22	0.13	0.13	0.17	0.17	0.17	0.22	0.22	0.22	0.17

TABLE 109. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 256 THROUGH 270

λ (μ)	CODE	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270
0.4	0.13	0.34	0.35	0.31	0.32	0.28	0.28	0.06	0.05	0.47	0.47	0.43	0.43	0.39	0.41	
0.45	0.07	0.40	0.40	0.30	0.30	0.24	0.25	0.06	0.05	0.48	0.48	0.44	0.44	0.43	0.44	
0.5	0.10	0.45	0.45	0.34	0.34	0.29	0.29	0.05	0.05	0.48	0.48	0.44	0.44	0.46	0.46	
0.55	0.17	0.55	0.55	0.44	0.44	0.38	0.38	0.05	0.05	0.48	0.48	0.44	0.44	0.48	0.48	
0.6	0.08	0.40	0.40	0.30	0.30	0.25	0.25	0.05	0.05	0.48	0.48	0.44	0.44	0.50	0.49	
0.65	0.12	0.45	0.45	0.35	0.35	0.29	0.29	0.30	0.06	0.05	0.48	0.48	0.44	0.44	0.51	0.50
0.7	0.20	0.55	0.56	0.45	0.45	0.38	0.39	0.06	0.06	0.47	0.48	0.44	0.44	0.52	0.51	
1.0	0.55	0.82	0.82	0.72	0.72	0.63	0.63	0.06	0.06	0.45	0.45	0.43	0.43			
1.5	0.47	0.60	0.60	0.58	0.58	0.49	0.49	0.05	0.05	0.54	0.54	0.52	0.52			
2.0	0.42	0.51	0.51	0.49	0.49	0.44	0.44	0.05	0.05	0.53	0.53	0.50	0.50			
2.5	0.42	0.45	0.45	0.45	0.45	0.37	0.37	0.05	0.05	0.58	0.58	0.53	0.53			
3.0	0.25	0.25	0.23	0.27	0.27	0.25	0.25	0.05	0.05	0.57	0.57	0.53	0.53			
3.5	0.13	0.13	0.13	0.17	0.17	0.13	0.13	0.07	0.07	0.54	0.54	0.50	0.50			

TABLE 110. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 271 THROUGH 285

λ (μ)	CODE 271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	
0.4	0.28	0.27	0.26	0.44	0.48	0.50	0.48	0.36	0.37	0.41	0.47	0.48	0.77	0.78	0.44	
0.45	0.29	0.28	0.27	0.63	0.63	0.54	0.52	0.41	0.42	0.57	0.60	0.59	0.78	0.79	0.63	
0.5	0.30	0.29	0.27	0.72	0.57	0.57	0.55	0.44	0.45	0.65	0.67	0.65	0.77	0.78	0.72	
0.55	0.31	0.30	0.28	0.78	0.59	0.59	0.57	0.47	0.48	0.70	0.69	0.67	0.77	0.78	0.78	
0.6	0.32	0.31	0.29	0.80	0.61	0.60	0.59	0.49	0.50	0.72	0.69	0.67	0.76	0.77	0.80	
0.65	0.32	0.31	0.29	0.80	0.61	0.60	0.60	0.51	0.52	0.71	0.68	0.66	0.75	0.76	0.80	
0.7	0.32	0.32	0.29	0.80	0.62	0.61	0.61	0.52	0.53	0.71	0.67	0.66	0.74	0.75	0.80	
1.0					0.76	0.59	0.57	0.59	0.49	0.49	0.67	0.65	0.63	0.70	0.70	0.75
1.5					0.73	0.64	0.64	0.66	0.56	0.54	0.61	0.57	0.56	0.60	0.61	0.73
2.0					0.74	0.60	0.57	0.60	0.51	0.51	0.61	0.59	0.59	0.60	0.61	0.75
2.5					0.68	0.65	0.62	0.65	0.54	0.54	0.57	0.54	0.54	0.56	0.57	0.68
3.0					0.64	0.66	0.66	0.70	0.63	0.63	0.52	0.45	0.47	0.50	0.50	0.64
3.5					0.67	0.74	0.68	0.74	0.62	0.62	0.59	0.54	0.54	0.59	0.61	0.67

TABLE III. HEMISPHERICAL SPECTRAL REFLECTANCE & CODE 286 THROUGH 300

TABLE 1112. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 301 THROUGH 313

λ (μ) \ CODE	301	302	303	304	305	306	307	308	309	310	311	312	313
0.4	0.58	0.66	0.08	0.09	0.54	0.44	0.41	0.39	0.29	0.28	0.93	0.80	0.08
0.45	0.84	0.88	0.08	0.08	0.62	0.50	0.47	0.46	0.37	0.36	0.93		
0.5	0.89	0.91	0.07	0.07	0.66	0.56	0.52	0.52	0.46	0.45	0.93	0.70	0.07
0.55	0.90	0.92	0.07	0.07	0.70	0.61	0.58	0.58	0.54	0.53	0.93		
0.6	0.90	0.91	0.07	0.06	0.73	0.65	0.61	0.62	0.59	0.58	0.93		
0.65	0.89	0.91	0.06	0.06	0.74	0.65	0.63	0.63	0.60	0.59	0.93		
0.7	0.88	0.90	0.06	0.05	0.75	0.65	0.63	0.63	0.60	0.60	0.93	0.50	0.06
1.0											0.94	0.19	0.08
1.5											0.95	0.26	0.09
2.0											0.92	0.22	0.12
2.5											0.89	0.18	0.12
3.0											0.88	0.14	0.11
3.5											0.87	0.16	0.12

TABLE 113. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 314 THROUGH 323

λ (μ)	CODE 314	315	316	317	318	319	320	321	322	323
0.4	0.41	0.42	0.43	0.44	0.44	0.41	0.41	0.40	0.42	0.43
0.45	0.42	0.43	0.44	0.45	0.45	0.43	0.44	0.42	0.45	0.45
0.5	0.43	0.44	0.45	0.46	0.46	0.43	0.44	0.42	0.45	0.46
0.55	0.44	0.44	0.46	0.46	0.46	0.43	0.44	0.42	0.45	0.46
0.6	0.43	0.44	0.45	0.45	0.45	0.43	0.44	0.42	0.45	0.46
0.65	0.48	0.50	0.49	0.50	0.50	0.47	0.48	0.46	0.50	0.52
0.7	0.49	0.51	0.53	0.51	0.52	0.50	0.51	0.48	0.52	0.54
1.0	0.56	0.57	0.59	0.59	0.58	0.56	0.56	0.55	0.58	0.59
1.5	0.60	0.62	0.64	0.62	0.64	0.60	0.61	0.59	0.62	0.63
2.0	0.68	0.69	0.70	0.70	0.70	0.69	0.69	0.69	0.69	0.70
2.5	0.74	0.76	0.76	0.76	0.77	0.77	0.77	0.76	0.76	0.76
3.0	0.74	0.76	0.76	0.77	0.77	0.77	0.76	0.76	0.76	0.76
3.5	0.74	0.76	0.76	0.76	0.77	0.77	0.77	0.76	0.76	0.76

TABLE 114. HEMISPHERICAL SPECTRAL REFLECTANCE & CODE 324 THROUGH 334

λ (μ) \ CODE	324	325	326	327	328	329	330	331	332	333	334
0.4	0.43	0.43	0.43	0.43	0.42	0.41	0.41	0.41	0.44	0.44	0.42
0.45	0.45	0.45	0.46	0.46	0.44	0.44	0.44	0.44	0.46	0.46	0.44
0.5	0.46	0.46	0.47	0.46	0.46	0.45	0.45	0.45	0.47	0.47	0.44
0.55	0.46	0.46	0.47	0.46	0.46	0.46	0.46	0.45	0.47	0.47	0.45
0.6	0.46	0.46	0.47	0.47	0.46	0.46	0.47	0.46	0.47	0.42	0.46
0.65	0.52	0.52	0.52	0.51	0.51	0.51	0.51	0.51	0.52	0.48	0.51
0.7	0.55	0.55	0.55	0.55	0.55	0.55	0.56	0.55	0.55	0.55	0.53
1.0	0.62	0.63	0.63	0.62	0.63	0.62	0.63	0.63	0.62	0.62	0.59
1.5	0.68	0.68	0.67	0.67	0.69	0.68	0.69	0.67	0.66	0.65	0.66
2.0	0.74	0.74	0.73	0.73	0.75	0.75	0.76	0.76	0.76	0.76	0.78
2.5	0.81	0.81	0.80	0.80	0.81	0.80	0.81	0.80	0.80	0.80	0.80
3.0	0.81	0.81	0.80	0.80	0.81	0.80	0.81	0.80	0.80	0.80	0.80
3.5	0.81	0.81	0.80	0.80	0.81	0.81	0.81	0.81	0.80	0.80	0.80

TABLE 115. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 335 THROUGH 340

TABLE 116. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 341 THROUGH 345

TABLE 116. HEMISPHERICAL SPECTRAL REFLECTANCE α CODE 341 THROUGH 345

λ (μ) \ CODE	341	342	343	344	345
0.4	0.14	0.53	0.59	0.53	0.66
0.45	0.15	0.62	0.62	0.59	0.62
0.5	0.17	0.68	0.65	0.66	0.67
0.55	0.18	0.67	0.65	0.67	0.66
0.6	0.18	0.65	0.69	0.72	0.68
0.65	0.18	0.66	0.69	0.73	0.70
0.7	0.18	0.66	0.69	0.73	0.70
1.0	0.22	0.67	0.71	0.76	0.71
1.5	0.27	0.69	0.70	0.77	0.71
2.0	0.34	0.64	0.69	0.76	0.70
2.5	0.35	0.60	0.68	0.76	0.69
3.0					
3.5					

DATA SECTION IV
NORMAL SPECTRAL EMISSIVITY

TABLE 117. NORMAL SPECTRAL EMISSIVITY ϵ CODE 1 THROUGH 10

CODE λ (μ)	1	2	3	4	5	6	7	8	9	10
4.0	0.41	0.45	0.51	0.53	0.57	0.54	0.50	0.55	0.75	0.71
4.5	0.42	0.42	0.48	0.58	0.60	0.53	0.46	0.53	0.61	0.59
5.0	0.44	0.48	0.52	0.76	0.76	0.56	0.48	0.61	0.61	0.60
5.5	0.51	0.59	0.58	0.90	0.90	0.59	0.54	0.70	0.68	0.64
6.0	0.80	0.77	0.75	0.93	0.93	0.66	0.65	0.85	0.75	0.71
6.5	0.90	0.90	0.88	0.94	0.94	0.73	0.72	0.93	0.82	0.79
7.0	0.92	0.94	0.92	0.95	0.95	0.80	0.80	0.96	0.91	0.86
7.5	0.94	0.96	0.95	0.96	0.96	0.86	0.86	0.97	0.92	0.89
8.0	0.96	0.96	0.96	0.98	0.98	0.91	0.91	0.98	0.99	0.96
8.5	0.97	0.99	0.98	0.95	0.95	0.95	0.92	0.99	0.99	0.99
9.0	0.99	0.99	0.99	0.91	0.90	0.99	0.97	0.99	0.99	0.99
9.5	0.99	0.99	0.97	0.92	0.89	0.98	0.96	0.98	0.98	0.96
10.0	0.97	0.96	0.96	0.93	0.94	0.97	0.96	0.97	0.98	0.95
10.5	0.85	(0.86)	(0.87)	(0.94)	(0.94)	(0.98)	(0.97)	0.80	0.98	(0.97)
11.0	0.74	0.76	0.75	0.95	0.94	0.99	0.98	0.65	0.99	0.99
12.0	0.76	0.80	0.80	0.98	0.98	0.97	0.99	0.67	0.99	0.99
13.0	0.81	0.77	0.80	0.97	0.97	0.95	0.98	0.74	0.99	0.99
13.5	0.77	0.78	0.74	0.97	0.99	0.91	0.90	0.71	0.88	0.88

TABLE 118. NORMAL SPECTRAL EMISSIVITY ϵ CODE 11 THROUGH 20

CODE λ (μ) \	11	12	13	14	15	16	17	18	19	20
4.0	0.80	0.82	0.86	0.86	0.70	0.75	0.60	0.60	(0.05)	(0.05)
4.5	0.70	0.74	0.80	0.82	0.59	0.62	0.43	0.46	0.05	0.05
5.0	0.73	0.77	0.73	0.75	0.50	0.53	0.42	0.46	0.06	0.06
5.5	0.78	0.85	0.80	0.81	0.56	0.59	0.49	0.54	0.06	0.06
6.0	0.85	0.89	0.88	0.91	0.70	0.73	0.53	0.59	0.06	0.06
6.5	0.87	0.91	0.93	0.94	0.85	0.88	0.61	0.67	0.05	0.05
7.0	0.93	0.95	0.95	0.94	0.92	0.92	0.70	0.75	0.06	0.06
7.5	0.93	0.95	0.93	0.94	0.91	0.91	0.68	0.75	0.06	0.06
8.0	0.99	0.99	0.96	0.95	0.93	0.92	0.89	0.92	0.06	0.07
8.5	0.99	0.99	0.97	0.97	0.93	0.93	0.96	0.94	0.06	0.06
9.0	0.99	0.99	0.97	0.97	0.94	0.94	0.97	0.97	0.06	0.06
9.5	0.99	0.99	0.93	0.94	0.92	0.90	0.93	0.93	0.06	0.06
10.0	0.99	0.99	0.92	0.92	0.91	0.91	0.94	0.94	0.05	0.05
10.5	0.99	(0.99)	0.94	0.94	0.89	0.91	0.97	0.97	0.06	0.06
11.0	0.99	0.99	0.95	0.96	0.91	0.92	0.98	0.98	0.05	0.05
12.0	0.99	0.99	0.94	0.91	0.94	0.95	0.97	0.98	(0.05)	(0.05)
13.0	0.94	0.98	0.97	0.99	0.94	0.95	0.94	0.96	(0.05)	(0.05)
13.5	0.92	0.90	0.89	0.96	0.91	0.93	0.87	0.92	(0.05)	(0.05)

TABLE 119. NORMAL SPECTRAL EMISSIVITY ϵ CODE 21 THROUGH 30

CODE λ (μ) \	21	22	23	24	25	26	27	28	29	30
4.0	0.47	0.47	0.55	0.60	0.32	0.36	0.39	0.54	0.24	0.24
4.5	0.47	0.47	0.54	0.60	0.31	0.35	0.37	0.53	0.23	0.24
5.0	0.45	0.46	0.54	0.60	0.30	0.31	0.34	0.50	0.22	0.22
5.5	0.43	0.44	0.52	0.57	0.27	0.30	0.31	0.48	0.22	0.21
6.0	0.42	0.43	0.50	0.57	0.26	0.29	0.31	0.47	0.20	0.20
6.5	0.42	0.41	0.49	0.55	0.25	0.28	0.29	0.43	0.19	0.19
7.0	0.42	0.41	0.49	0.55	0.27	0.37	0.36	0.53	0.18	0.18
7.5	0.39	0.39	0.48	0.53	0.25	0.31	0.31	0.53	0.17	0.17
8.0	0.37	0.38	0.45	0.54	0.24	0.28	0.29	0.48	0.17	0.17
8.5	0.37	0.37	0.44	0.53	0.22	0.25	0.26	0.45	0.17	0.16
9.0	0.38	0.38	0.43	0.53	0.20	0.25	0.25	0.43	0.17	0.17
9.5	0.35	0.35	0.43	0.50	0.20	0.24	0.25	0.41	0.17	0.15
10.0	0.33	0.34	0.40	0.47	0.20	0.25	0.24	0.40	0.16	0.15
10.5	0.32	0.33	0.39	0.45	0.19	0.21	0.23	0.42	0.15	0.16
11.0	0.31	0.31	0.37	0.44	0.19	0.22	0.23	0.36	0.14	0.14
12.0	0.30	0.29	0.33	0.40	0.18	0.19	0.22	0.34	0.14	0.14
13.0	0.30	(0.29)	0.32	0.43	(0.18)	0.17	0.18	0.28	(0.14)	(0.14)
13.5	0.28	0.29	0.31	0.43	(0.18)	(0.17)	(0.18)	0.31	(0.14)	(0.14)

TABLE 120. NORMAL SPECTRAL EMISSIVITY ϵ CODE 31 THROUGH 40

CODE λ (μ) \	31	32	33	34	35	36	37	38	39	40
4.0	0.38	0.38	0.41	0.38	0.36	0.38	0.36	0.53	0.57	0.52
4.5	0.37	0.37	0.42	0.36	0.35	0.35	0.35	0.60	0.60	0.56
5.0	0.37	0.37	0.45	0.45	0.40	0.40	0.40	0.75	0.76	0.77
5.5	0.36	0.36	0.56	0.56	0.54	0.54	0.54	0.90	0.91	0.90
6.0	0.34	0.34	0.80	0.74	0.75	0.72	0.71	0.93	0.95	0.92
6.5	0.34	0.34	0.90	0.87	0.86	0.83	0.84	0.94	0.96	0.92
7.0	0.34	0.34	0.93	0.93	0.90	0.90	0.88	0.95	0.94	0.94
7.5	0.33	0.33	0.95	0.96	0.92	0.94	0.92	0.96	0.98	0.96
8.0	0.33	0.33	0.96	0.96	0.93	0.97	0.96	0.98	0.99	0.99
8.5	0.33	0.32	0.98	0.98	0.98	0.97	0.98	0.95	0.98	0.98
9.0	0.32	0.33	0.99	0.99	0.99	0.99	0.99	0.91	0.94	0.91
9.5	0.30	0.33	0.99	0.99	0.99	0.99	0.99	0.92	0.92	0.90
10.0	0.30	0.32	0.98	0.96	0.94	0.94	0.86	0.93	0.94	0.96
10.5	0.31	0.32	0.85	0.87	0.78	0.76	0.68	0.94	0.97	0.95
11.0	0.28	0.30	0.73	0.84	0.72	0.74	0.70	0.95	0.97	0.95
12.0	0.27	0.29	0.76	0.85	0.73	0.79	0.78	0.98	0.99	0.96
13.0	0.27	0.28	0.81	0.73	0.76	0.77	0.75	0.98	0.97	0.96
13.5	(0.27)	(0.28)	0.77	0.71	0.75	0.78	0.77	0.98	0.99	0.98

TABLE 121. NORMAL SPECTRAL EMISSIVITY ϵ CODE 41 THROUGH 50

CODE λ (μ) \	41	42	43	44	45	46	47	48	49	50
4.0	0.52	0.51	0.54	0.48	0.44	0.45	0.46	0.55	0.50	0.49
4.5	0.57	0.55	0.53	0.46	0.44	0.42	0.45	0.53	0.50	0.48
5.0	0.73	0.75	0.55	0.51	0.46	0.48	0.48	0.60	0.58	0.56
5.5	0.88	0.86	0.59	0.53	0.50	0.53	0.51	0.70	0.69	0.66
6.0	0.94	0.90	0.65	0.60	0.59	0.59	0.58	0.85	0.82	0.83
6.5	0.95	0.91	0.73	0.68	0.65	0.65	0.67	0.93	0.90	0.90
7.0	0.92	0.91	0.80	0.75	0.70	0.71	0.73	0.95	0.92	0.91
7.5	0.95	0.93	0.86	0.82	0.76	0.78	0.76	0.96	0.95	0.95
8.0	0.98	0.97	0.91	0.85	0.81	0.84	0.82	0.97	0.96	0.97
8.5	0.97	0.94	0.96	0.88	0.86	0.85	0.84	0.98	0.98	0.98
9.0	0.92	0.90	0.99	0.92	0.88	0.90	0.87	0.98	0.98	0.98
9.5	0.88	0.90	0.98	0.91	0.87	0.89	0.88	0.98	0.98	0.98
10.0	0.94	0.91	0.97	0.90	0.87	0.90	0.88	0.96	0.96	0.94
10.5	0.95	0.93	0.97	0.90	0.88	0.92	0.88	0.80	0.68	(0.86)
11.0	0.93	0.92	0.99	0.92	0.88	0.90	0.88	0.64	0.64	0.64
12.0	0.97	0.96	0.97	0.96	0.91	0.93	0.90	0.66	0.68	0.68
13.0	0.99	0.95	0.95	0.91	0.89	0.89	0.85	0.74	0.70	0.73
13.5	0.96	0.93	0.90	0.89	0.89	0.87	0.81	0.70	0.70	0.70

TABLE 122. NORMAL SPECTRAL EMISSIVITY ϵ CODE 51 THROUGH 60

CODE λ (μ) \	51	52	53	54	55	56	57	58	59	60
4.0	0.49	0.48	(0.85)	(0.94)	(0.89)	(0.87)	(0.91)	0.80	0.66	0.68
4.5	0.48	0.48	(0.85)	(0.94)	(0.89)	(0.87)	(0.91)	0.70	0.60	0.60
5.0	0.55	0.55	0.85	0.94	0.89	0.87	0.91	0.73	0.68	0.66
5.5	0.67	0.65	0.90	0.98	0.95	0.92	0.95	0.78	0.75	0.74
6.0	0.84	0.81	0.92	0.97	0.97	0.94	0.94	0.84	0.78	0.80
6.5	0.92	0.90	0.91	0.93	0.96	0.94	0.95	0.88	0.82	0.81
7.0	0.92	0.94	0.88	0.95	0.97	0.91	0.95	0.92	0.84	0.83
7.5	0.95	0.95	0.91	0.99	0.96	0.92	0.82	0.94	0.86	0.84
8.0	0.96	0.97	0.77	0.81	0.77	0.64	0.50	0.99	0.88	0.87
8.5	0.96	0.98	0.58	0.58	0.58	0.56	0.57	0.99	0.89	0.91
9.0	0.98	0.98	0.42	0.43	0.41	0.48	0.56	0.99	0.91	0.96
9.5	0.98	0.98	0.60	0.67	0.66	0.72	0.78	0.99	0.88	0.87
10.0	0.91	0.84	0.74	0.82	0.81	0.84	0.90	0.99	0.87	0.88
10.5	0.67	0.62	0.83	0.87	0.83	0.87	0.93	0.99	0.89	0.88
11.0	0.61	0.61	0.88	0.89	0.89	0.92	0.94	0.99	0.88	0.90
12.0	0.67	0.67	0.90	0.93	0.91	0.93	0.94	0.99	0.89	0.89
13.0	0.73	0.73	0.89	0.93	0.90	0.93	0.90	0.94	0.80	0.83
13.5	0.73	0.70	0.89	0.93	0.87	0.93	0.95	0.90	0.81	0.79

TABLE 123. NORMAL SPECTRAL EMISSIVITY ϵ CODE 61 THROUGH 70

CODE λ (μ) \	61	62	63	64	65	66	67	68	69	70
4.0	0.65	0.65	0.47	0.47	0.47	0.47	0.48	0.60	0.54	0.56
4.5	0.62	0.60	0.47	0.44	0.47	0.48	0.48	0.60	0.55	0.58
5.0	0.66	0.66	0.45	0.43	0.45	0.50	0.47	0.60	0.52	0.57
5.5	0.70	0.74	0.43	0.43	0.44	0.48	0.48	0.57	0.52	0.56
6.0	0.78	0.76	0.42	0.42	0.42	0.46	0.48	0.57	0.53	0.55
6.5	0.83	0.80	0.42	0.42	0.42	0.46	0.48	0.55	0.52	0.54
7.0	0.83	0.85	0.42	0.40	0.41	0.46	0.47	0.55	0.50	0.53
7.5	0.86	0.86	0.39	0.39	0.37	0.44	0.46	0.53	0.47	0.52
8.0	0.88	0.85	0.37	0.37	0.37	0.43	0.45	0.53	0.48	0.51
8.5	0.88	0.87	0.36	0.34	0.35	0.43	0.46	0.53	0.48	0.50
9.0	0.88	0.86	0.37	0.35	0.37	0.44	0.47	0.52	0.47	0.50
9.5	0.86	0.86	0.34	0.32	0.34	0.43	0.46	0.50	0.44	0.37
10.0	0.88	0.85	0.32	0.33	0.32	0.43	0.44	0.48	0.44	0.36
10.5	0.91	0.87	0.32	0.30	0.32	0.40	0.42	0.45	0.40	0.34
11.0	0.90	0.88	0.31	0.27	0.28	0.37	0.40	0.44	0.39	0.32
12.0	0.87	0.84	0.30	0.27	0.27	0.38	0.41	0.40	0.37	0.30
13.0	0.82	0.76	0.29	0.25	0.24	0.37	0.38	0.39	0.36	0.28
13.5	0.79	0.76	(0.29)	0.27	(0.24)	0.41	0.44	0.38	0.34	0.24

TABLE 124. NORMAL SPECTRAL EMISSIVITY ϵ CODE 71 THROUGH 80

CODE λ (μ) \	71	72	73	74	75	76	77	78	79	80
4.0	0.57	0.60	0.33	0.33	0.33	0.37	0.43	0.54	0.54	0.58
4.5	0.59	0.59	0.32	0.32	0.33	0.36	0.40	0.53	0.53	0.58
5.0	0.58	0.56	0.30	0.28	0.30	0.34	0.38	0.51	0.48	0.54
5.5	0.56	0.55	0.27	0.28	0.28	0.34	0.38	0.49	0.47	0.53
6.0	0.56	0.55	0.25	0.25	0.28	0.32	0.37	0.47	0.46	0.48
6.5	0.56	0.54	0.25	0.24	0.26	0.33	0.35	0.44	0.44	0.48
7.0	0.56	0.54	0.27	0.29	0.30	0.37	0.40	0.53	0.53	0.60
7.5	0.55	0.53	0.25	0.25	0.26	0.33	0.36	0.53	0.52	0.55
8.0	0.54	0.53	0.24	0.22	0.24	0.31	0.35	0.49	0.46	0.49
8.5	0.52	0.53	0.22	0.21	0.22	0.31	0.35	0.45	0.43	0.46
9.0	0.52	0.55	0.20	0.20	0.22	0.30	0.35	0.43	0.40	0.46
9.5	0.53	0.53	0.21	0.18	0.20	0.31	0.33	0.41	0.40	0.43
10.0	0.52	0.51	0.20	0.18	0.20	0.30	0.33	0.41	0.38	0.43
10.5	0.51	0.51	0.19	0.17	0.18	0.28	0.30	0.42	0.36	0.39
11.0	0.46	0.48	0.18	0.16	0.17	0.28	0.30	0.36	0.33	0.36
12.0	0.48	0.47	0.18	0.16	0.16	0.27	0.28	0.34	0.32	0.34
13.0	0.46	0.47	(0.18)	(0.16)	(0.16)	0.31	0.28	0.29	0.30	0.32
13.5	0.44	0.45	(0.18)	(0.16)	(0.16)	0.31	0.28	0.31	0.30	0.28

TABLE 125. NORMAL SPECTRAL EMISSIVITY ϵ CODE 81 THROUGH 90

CODE λ (μ) \	81	82	83	84	85	86	87	88	89	90
4.0	0.56	0.60	0.38	0.37	0.35	0.44	0.43	0.24	0.26	0.32
4.5	0.54	0.56	0.37	0.34	0.34	0.41	0.43	0.23	0.22	0.30
5.0	0.54	0.55	0.36	0.33	0.34	0.42	0.43	0.22	0.19	0.29
5.5	0.51	0.53	0.36	0.32	0.33	0.41	0.43	0.22	0.18	0.28
6.0	0.49	0.51	0.35	0.31	0.32	0.40	0.43	0.20	0.17	0.27
6.5	0.50	0.53	0.35	0.32	0.32	0.40	0.43	0.18	0.16	0.28
7.0	0.60	0.61	0.33	0.31	0.32	0.41	0.43	0.18	0.15	0.26
7.5	0.57	0.58	0.33	0.30	0.30	0.41	0.43	0.17	0.15	0.26
8.0	0.52	0.53	0.33	0.30	0.29	0.40	0.42	0.17	0.14	0.26
8.5	0.48	0.52	0.32	0.30	0.29	0.39	0.42	0.17	0.14	0.25
9.0	0.48	0.53	0.32	0.30	0.29	0.39	0.43	0.17	0.13	0.25
9.5	0.48	0.51	0.30	0.29	0.28	0.39	0.41	0.17	0.13	0.26
10.0	0.47	0.50	0.30	0.29	0.27	0.40	0.39	0.16	0.13	0.25
10.5	0.43	0.46	0.31	0.28	0.25	0.39	0.38	0.15	0.12	0.25
11.0	0.42	0.45	0.28	0.28	0.24	0.37	0.36	0.14	0.11	0.24
12.0	0.42	0.43	0.28	0.27	0.24	0.38	0.35	0.14	(0.11)	0.23
13.0	0.41	0.42	0.27	0.28	0.24	0.38	0.37	(0.14)	(0.11)	0.25
13.5	0.43	0.42	(0.27)	0.28	(0.24)	0.37	0.37	(0.14)	(0.11)	(0.25)

TABLE 126. NORMAL SPECTRAL EMISSIVITY ϵ CODE 91 THROUGH 100

CODE λ (μ) \	91	92	93	94	95	96	97	98	99	100
4.0	0.38	0.26	0.38	0.36	0.35	0.45	0.48	0.47	0.54	0.29
4.5	0.36	0.24	0.36	0.40	0.34	0.46	0.52	0.44	0.62	0.34
5.0	0.35	0.22	0.42	0.43	0.41	0.54	0.69	0.36	0.58	0.36
5.5	0.33	0.22	0.52	0.53	0.54	0.65	0.83	0.40	0.55	0.38
6.0	0.33	0.19	0.65	0.66	0.71	0.77	0.86	0.50	0.67	0.37
6.5	0.32	0.19	0.76	0.76	0.82	0.85	0.87	0.66	0.77	0.37
7.0	0.32	0.17	0.79	0.79	0.85	0.83	0.86	0.64	0.76	0.35
7.5	0.31	0.16	0.83	0.82	0.89	0.89	0.90	0.80	0.83	0.38
8.0	0.31	0.16	0.87	0.87	0.90	0.91	0.90	0.89	0.87	0.40
8.5	0.31	0.16	0.87	0.87	0.93	0.91	0.89	0.86	0.85	0.36
9.0	0.32	0.16	0.89	0.90	0.96	0.94	0.86	0.90	0.88	0.36
9.5	0.30	0.15	0.86	0.85	0.96	0.93	0.86	0.90	0.86	0.36
10.0	0.29	0.15	(0.83)	(0.82)	(0.82)	(0.76)	(0.86)	(0.90)	(0.87)	(0.34)
10.5	0.28	0.14	0.80	0.79	0.77	0.70	0.87	0.89	0.88	0.33
11.0	0.28	0.13	(0.64)	(0.65)	(0.71)	(0.64)	(0.90)	(0.91)	(0.88)	(0.29)
12.0	0.28	(0.13)	(0.68)	(0.68)	(0.75)	(0.71)	(0.91)	(0.89)	(0.85)	(0.26)
13.0	0.27	(0.13)	(0.68)	(0.68)	(0.75)	(0.71)	(0.91)	(0.89)	(0.85)	(0.26)
13.5	0.29	(0.13)	0.63	0.62	0.71	0.69	0.91	0.85	0.80	(0.26)

TABLE 127. NORMAL SPECTRAL EMISSIVITY ϵ CODE 101 THROUGH 110

CODE λ (μ) \	101	102	103	104	105	106	107	108	109	110
4.0	(0.14)	0.40	(0.20)	0.48	0.47	(0.85)	0.81	0.37	0.37	0.37
4.5	(0.14)	0.43	0.20	0.51	0.48	(0.85)	0.77	0.37	0.36	0.37
5.0	0.14	0.44	0.22	0.48	0.49	0.85	0.73	0.37	0.36	0.37
5.5	0.17	0.44	0.21	0.49	0.49	0.90	0.66	0.36	0.35	0.36
6.0	0.16	0.44	0.20	0.48	0.49	0.92	0.61	0.37	0.36	0.36
6.5	0.15	0.43	0.18	0.46	0.49	0.91	0.54	0.36	0.36	0.36
7.0	0.13	0.40	0.19	0.44	0.47	0.88	0.51	0.35	0.34	0.35
7.5	0.16	0.43	0.19	0.44	0.47	0.92	0.48	0.35	0.34	0.35
8.0	0.17	0.43	0.19	0.43	0.46	0.77	0.46	0.36	0.35	0.35
8.5	0.15	0.39	0.18	0.41	0.47	0.58	0.44	0.35	0.34	0.35
9.0	0.14	0.38	0.18	0.41	0.47	0.41	0.44	0.38	0.37	0.37
9.5	0.13	0.37	0.17	0.39	0.49	0.61	0.44	0.36	0.35	0.35
10.0	(0.13)	(0.36)	(0.17)	(0.37)	(0.48)	(0.72)	(0.42)	0.34	0.31	0.32
10.5	0.12	0.35	(0.17)	0.35	0.47	0.83	0.39	0.31	0.30	0.30
11.0	(0.12)	(0.30)	(0.17)	(0.34)	(0.47)	(0.90)	(0.37)	0.29	0.28	0.29
12.0	(0.12)	(0.27)	(0.17)	(0.34)	(0.47)	(0.89)	(0.37)	0.30	0.28	0.30
13.0	(0.12)	(0.27)	(0.17)	(0.34)	(0.46)	(0.89)	(0.37)	0.28	0.28	0.27
13.5	(0.12)	(0.27)	0.17	(0.34)	(0.46)	0.89	(0.37)	(0.28)	(0.28)	(0.27)

TABLE 128. NORMAL SPECTRAL EMISSIVITY ϵ CODE 111 THROUGH 120

CODE λ (μ) \	111	112	113	114	115	116	117	118	119	120
4.0	0.37	0.37	0.37	0.07	0.07	0.07	0.21	0.43	0.20	0.79
4.5	0.36	0.37	0.36	0.07	0.07	0.07	0.20	0.38	0.19	0.60
5.0	0.37	0.37	0.35	0.07	0.07	0.07	0.20	0.37	0.20	0.56
5.5	0.36	0.37	0.35	0.07	0.07	0.07	0.19	0.33	0.19	0.47
6.0	0.37	0.37	0.37	0.05	0.05	0.05	0.19	0.33	0.18	0.48
6.5	0.36	0.36	0.35	0.05	0.04	0.05	0.17	0.34	0.16	0.48
7.0	0.35	0.35	0.34	0.05	0.04	0.04	0.18	0.37	0.17	0.53
7.5	0.35	0.35	0.35	0.04	0.04	0.04	0.17	0.36	0.16	0.59
8.0	0.35	0.36	0.35	0.04	0.04	0.04	0.17	0.40	0.17	0.69
8.5	0.33	0.35	0.34	0.03	0.03	0.03	0.16	0.40	0.16	0.75
9.0	0.35	0.37	0.34	0.03	0.03	0.03	0.15	0.42	0.15	0.80
9.5	0.34	0.34	0.33	0.03	0.02	0.03	0.16	0.44	0.15	0.85
10.0	0.31	0.32	0.31	0.03	0.02	0.03	0.14	0.42	0.14	0.85
10.5	0.31	0.31	0.29	0.02	0.02	0.02	0.14	0.43	0.13	0.87
11.0	0.28	0.29	0.28	0.02	0.02	0.02	0.13	0.41	0.13	0.86
12.0	0.28	0.29	0.27	(0.02)	(0.02)	(0.02)	0.11	0.33	0.11	0.75
13.0	0.28	0.28	0.26	(0.02)	(0.02)	(0.02)	(0.11)	0.26	(0.11)	0.56
13.5	(0.28)	(0.28)	(0.26)	(0.02)	(0.02)	(0.02)	(0.11)	0.27	(0.11)	0.57

TABLE 129. NORMAL SPECTRAL EMISSIVITY ϵ CODE 121 THROUGH 130

CODE λ (μ) \	121	122	123	124	125	126	127	128	129	130
4.0	0.86	0.42	0.41	0.44	0.43	0.10	0.09	0.75	0.78	0.87
4.5	0.66	0.39	0.38	0.42	0.42	0.10	0.09	0.64	0.72	0.80
5.0	0.67	0.39	0.38	0.41	0.42	0.11	0.09	0.64	0.71	0.75
5.5	0.57	0.39	0.39	0.42	0.42	0.11	0.10	0.70	0.79	0.82
6.0	0.58	0.40	0.40	0.43	0.43	0.12	0.11	0.77	0.84	0.93
6.5	0.61	0.39	0.39	0.42	0.41	0.12	0.11	0.81	0.88	0.95
7.0	0.64	0.38	0.37	0.41	0.41	0.12	0.11	0.87	0.91	0.95
7.5	0.67	0.37	0.37	0.39	0.38	0.11	0.11	0.91	0.92	0.97
8.0	0.81	0.38	0.38	0.39	0.39	0.12	0.11	0.96	0.97	0.96
8.5	0.80	0.41	0.40	0.41	0.41	0.12	0.11	0.99	0.99	0.97
9.0	0.87	0.43	0.42	0.43	0.42	0.12	0.11	0.97	0.97	0.95
9.5	0.91	0.41	0.40	0.42	0.40	0.12	0.11	0.97	0.95	0.95
10.0	0.91	0.39	0.36	0.38	0.38	0.12	0.11	0.96	0.93	0.94
10.5	0.91	0.36	0.35	0.36	0.36	0.12	0.11	0.97	0.96	0.93
11.0	0.90	0.36	0.34	0.36	0.35	0.13	0.11	0.98	0.96	0.95
12.0	0.79	0.37	0.33	0.35	0.35	0.13	0.11	0.99	0.99	0.98
13.0	0.64	0.35	0.30	0.32	0.31	(0.13)	(0.11)	0.95	0.97	0.95
13.5	0.56	0.32	0.30	0.31	0.31	(0.13)	(0.11)	0.91	0.89	0.97

TABLE 130. NORMAL SPECTRAL EMISSIVITY ϵ CODE 131 THROUGH 140

CODE λ (μ) \	131	132	133	134	135	136	137	138	139	140
4.0	0.87	0.70	0.80	0.88	0.87	0.71	0.77	(0.15)	(0.15)	0.60
4.5	0.82	0.58	0.73	0.85	0.85	0.68	0.72	0.15	0.15	0.62
5.0	0.77	0.60	0.74	0.82	0.83	0.69	0.73	0.14	0.14	0.60
5.5	0.83	0.67	0.85	0.87	0.88	0.77	0.83	0.15	0.15	0.58
6.0	0.94	0.73	0.91	0.94	0.94	0.83	0.89	0.17	0.16	0.60
6.5	0.95	0.78	0.94	0.98	0.99	0.88	0.91	0.17	0.17	0.64
7.0	0.97	0.82	0.96	0.99	0.99	0.91	0.96	0.17	0.17	0.62
7.5	0.98	0.82	0.96	0.97	0.96	0.92	0.97	0.17	0.17	0.59
8.0	0.96	0.91	0.98	0.98	0.96	0.95	0.99	0.17	0.15	0.60
8.5	0.96	0.98	0.98	0.99	0.98	0.97	0.99	0.17	0.17	0.60
9.0	0.94	0.94	0.99	0.97	0.97	0.94	0.97	0.18	0.18	0.63
9.5	0.97	0.94	0.97	0.95	0.95	0.92	0.95	0.18	0.18	0.62
10.0	0.94	0.93	0.96	0.92	0.92	0.89	0.92	0.18	0.18	0.60
10.5	0.95	0.94	0.97	0.97	0.97	0.95	0.96	(0.18)	0.16	0.59
11.0	0.95	0.93	0.99	0.95	0.95	0.93	0.96	(0.18)	0.16	0.57
12.0	0.99	0.95	0.97	0.96	0.97	0.95	0.96	(0.18)	(0.16)	0.57
13.0	0.96	0.87	0.91	0.95	0.91	0.92	0.91	(0.18)	(0.16)	0.58
13.5	0.99	0.87	0.91	0.95	0.98	0.95	0.95	(0.18)	(0.16)	0.57

TABLE 131. NORMAL SPECTRAL EMISSIVITY ϵ CODE 141 THROUGH 150

CODE λ (μ) \	141	142	143	144	145	146	147	148	149	150
4.0	0.60	(0.15)	(0.14)	0.60	0.56	0.78	0.77	0.77	0.73	0.82
4.5	0.63	0.15	0.14	0.56	0.56	0.81	0.80	0.77	0.77	0.82
5.0	0.60	0.14	0.13	0.56	0.56	0.83	0.80	0.77	0.77	0.82
5.5	0.59	0.14	0.13	0.55	0.55	0.83	0.82	0.80	0.80	0.82
6.0	0.60	0.15	0.15	0.56	0.55	0.85	0.83	0.83	0.83	0.85
6.5	0.65	0.16	0.15	0.58	0.56	0.86	0.84	0.83	0.83	0.85
7.0	0.64	0.15	0.15	0.57	0.54	0.86	0.85	0.83	0.84	0.85
7.5	0.59	0.16	0.15	0.55	0.54	0.86	0.85	0.84	0.86	0.86
8.0	0.59	0.16	0.16	0.55	0.53	0.87	0.84	0.83	0.85	0.85
8.5	0.59	0.16	0.16	0.54	0.54	0.87	0.85	0.84	0.86	0.85
9.0	0.59	0.16	0.16	0.55	0.53	0.87	0.84	0.85	0.87	0.87
9.5	0.59	0.16	0.16	0.54	0.54	0.86	0.84	0.85	0.85	0.87
10.0	0.58	0.17	0.17	0.52	0.51	0.86	0.85	0.85	0.86	0.86
10.5	0.55	0.16	0.16	0.50	0.50	0.86	0.84	0.84	0.84	0.85
11.0	0.54	0.15	0.16	0.50	0.46	0.86	0.84	0.86	0.86	0.86
12.0	0.54	(0.15)	(0.16)	0.50	0.49	0.86	0.86	0.85	0.86	0.88
13.0	0.51	(0.15)	(0.16)	0.47	0.47	0.85	0.84	0.84	0.86	0.85
13.5	0.52	(0.15)	(0.16)	0.48	0.48	0.86	0.83	0.84	0.88	0.85

TABLE 132. NORMAL SPECTRAL EMISSIVITY ϵ CODE 151 THROUGH 160

CODE λ (μ) \	151	152	153	154	155	156	157	158	159	160
4.0	0.84	0.58	0.57	0.55	0.58	0.62	0.63	0.64	0.64	0.64
4.5	0.82	0.59	0.59	0.58	0.59	0.63	0.63	0.63	0.62	0.64
5.0	0.82	0.57	0.57	0.57	0.58	0.63	0.63	0.61	0.61	0.63
5.5	0.86	0.57	0.57	0.57	0.58	0.62	0.62	0.60	0.60	0.62
6.0	0.88	0.56	0.57	0.57	0.57	0.61	0.61	0.60	0.60	0.62
6.5	0.88	0.57	0.57	0.56	0.57	0.59	0.59	0.59	0.59	0.62
7.0	0.88	0.55	0.55	0.55	0.56	0.59	0.59	0.58	0.58	0.59
7.5	0.87	0.54	0.54	0.55	0.55	0.57	0.58	0.57	0.56	0.58
8.0	0.87	0.55	0.55	0.55	0.55	0.57	0.58	0.56	0.56	0.58
8.5	0.87	0.55	0.52	0.55	0.55	0.56	0.57	0.56	0.56	0.57
9.0	0.88	0.56	0.54	0.55	0.55	0.55	0.57	0.55	0.55	0.56
9.5	0.88	0.55	0.54	0.53	0.55	0.54	0.57	0.52	0.54	0.55
10.0	0.87	0.52	0.55	0.52	0.51	0.53	0.54	0.51	0.51	0.52
10.5	0.87	0.50	0.50	0.52	0.49	0.52	0.52	0.48	0.47	0.52
11.0	0.86	0.51	0.51	0.51	0.48	0.50	0.49	0.47	0.47	0.48
12.0	0.89	0.47	0.47	0.47	0.45	0.47	0.48	0.46	0.46	0.46
13.0	0.85	0.47	0.45	0.45	0.44	0.45	0.45	0.44	0.45	0.46
13.5	0.86	0.46	0.47	0.47	0.47	0.46	0.46	0.45	0.45	0.46

TABLE 133. NORMAL SPECTRAL EMISSIVITY ϵ CODE 161 THROUGH 170

CODE λ (μ) \	161	162	163	164	165	166	167	168	169	170
4.0	0.64	0.67	0.70	0.86	0.84	0.90	0.87	0.77	0.78	0.76
4.5	0.60	0.67	0.67	0.83	0.81	0.75	0.73	0.75	0.76	0.76
5.0	0.60	0.66	0.69	0.70	0.72	0.60	0.58	0.74	0.72	0.73
5.5	0.58	0.65	0.65	0.67	0.64	0.50	0.50	0.74	0.77	0.75
6.0	0.58	0.66	0.65	0.60	0.56	0.47	0.46	0.56	0.58	0.62
6.5	0.58	0.66	0.63	0.55	0.52	0.53	0.48	0.65	0.66	0.57
7.0	0.58	0.64	0.64	0.48	0.46	0.58	0.53	0.66	0.75	0.73
7.5	0.56	0.63	0.63	0.47	0.44	0.51	0.58	0.46	0.51	0.53
8.0	0.56	0.63	0.61	0.43	0.45	0.52	0.60	0.56	0.54	0.55
8.5	0.55	0.62	0.62	0.43	0.40	0.68	0.70	0.95	0.94	0.95
9.0	0.54	0.59	0.62	0.43	0.40	0.80	0.83	0.95	0.97	0.98
9.5	0.52	0.57	0.58	0.43	0.42	0.84	0.87	0.87	0.87	0.89
10.0	0.51	0.54	0.57	0.42	0.39	0.88	0.88	0.82	0.82	0.85
10.5	0.49	0.54	0.54	0.40	0.37	0.92	0.93	0.82	0.83	0.85
11.0	0.46	0.53	0.53	0.40	0.37	0.93	0.92	0.83	0.87	0.83
12.0	0.44	0.50	0.50	0.36	0.34	0.92	0.90	0.73	0.70	0.72
13.0	0.45	0.51	0.51	0.37	0.34	0.94	0.90	0.99	0.99	0.99
13.5	0.45	0.54	0.54	0.38	0.35	0.80	(0.90)	0.97	0.96	0.95

TABLE 134. NORMAL SPECTRAL EMISSIVITY ϵ CODE 171 THROUGH 180

CODE λ (μ) \	171	172	173	174	175	176	177	178	179	180
4.0	0.80	0.77	0.75	0.73	0.72	0.79	0.77	0.68	0.65	0.69
4.5	0.71	0.73	0.70	0.68	0.75	0.81	0.81	0.60	0.66	0.64
5.0	0.75	0.70	0.68	0.66	0.73	0.80	0.77	0.55	0.61	0.59
5.5	0.67	0.70	0.69	0.65	0.71	0.77	0.75	0.54	0.60	0.59
6.0	0.67	0.68	0.68	0.65	0.71	0.78	0.75	0.56	0.62	0.60
6.5	0.64	0.77	0.77	0.76	0.80	0.86	0.85	0.66	0.79	0.78
7.0	0.64	0.84	0.83	0.81	0.88	0.88	0.85	0.74	0.87	0.84
7.5	0.63	0.75	0.76	0.75	0.80	0.86	0.84	0.65	0.74	0.68
8.0	0.68	0.70	0.71	0.67	0.71	0.71	0.74	0.54	0.62	0.60
8.5	0.97	0.70	0.68	0.66	0.70	0.76	0.73	0.53	0.63	0.60
9.0	0.98	0.68	0.67	0.69	0.75	0.76	0.74	0.57	0.63	0.63
9.5	0.87	0.69	0.67	0.64	0.70	0.75	0.72	0.55	0.64	0.62
10.0	0.83	0.67	0.65	0.61	0.68	0.73	0.68	0.52	0.62	0.61
10.5	0.83	0.65	0.65	0.61	0.66	0.72	0.67	0.50	0.62	0.62
11.0	0.84	0.60	0.60	0.60	0.65	0.73	0.69	0.52	0.64	0.61
12.0	0.85	0.63	0.63	0.60	0.67	0.73	0.70	0.52	0.65	0.65
13.0	0.89	0.58	0.59	0.55	0.64	0.73	0.71	0.49	0.62	0.60
13.5	0.93	0.63	0.61	0.55	0.67	0.79	0.74	0.51	0.60	0.61

TABLE 135. NORMAL SPECTRAL EMISSIVITY ϵ CODE 181 THROUGH 190

CODE λ (μ) \	181	182	183	184	185	186	187	188	189	190
4.0	0.78	0.74	0.71	0.83	0.84	0.83	0.59	0.80	0.50	0.80
4.5	0.78	0.74	0.68	0.80	0.82	0.83	0.56	0.80	0.57	0.75
5.0	0.76	0.70	0.63	0.78	0.81	0.81	0.56	0.80	0.55	0.77
5.5	0.72	0.68	0.60	0.80	0.81	0.81	0.55	0.81	0.54	0.83
6.0	0.76	0.70	0.60	0.82	0.80	0.82	0.55	0.86	0.51	0.88
6.5	0.85	0.83	0.71	0.90	0.88	0.90	0.54	0.88	0.55	0.89
7.0	0.86	0.85	0.77	0.86	0.82	0.85	0.54	0.92	0.50	0.93
7.5	0.78	0.77	0.71	0.86	0.85	0.86	0.53	0.95	0.50	0.96
8.0	0.76	0.71	0.65	0.81	0.81	0.82	0.53	0.95	0.49	0.97
8.5	0.76	0.71	0.63	0.80	0.81	0.81	0.53	0.95	0.49	0.95
9.0	0.76	0.73	0.65	0.84	0.84	0.83	0.51	0.96	0.50	0.98
9.5	0.76	0.72	0.63	0.80	0.80	0.81	0.50	0.95	0.46	0.96
10.0	0.76	0.70	0.62	0.79	0.80	0.81	0.49	0.95	0.47	0.96
10.5	0.74	0.69	0.60	0.78	0.80	0.79	0.46	0.94	0.44	0.95
11.0	0.73	0.70	0.58	0.79	0.81	0.80	0.44	0.94	0.44	0.95
12.0	0.76	0.74	0.60	0.81	0.81	0.79	0.43	0.92	0.40	0.94
13.0	0.64	0.65	0.53	0.77	0.76	0.77	0.37	0.85	0.37	0.90
13.5	0.71	0.71	0.56	0.81	0.80	0.81	0.35	0.87	0.35	0.89

TABLE 136. NORMAL SPECTRAL EMISSIVITY ϵ CODE 191 THROUGH 200

CODE λ (μ) \	191	192	193	194	195	196	197	198	199	200
4.0	0.55	0.08	0.07	0.06	0.10	0.20	0.82	0.90	0.84	0.84
4.5	0.54	0.09	0.07	0.06	0.10	0.24	0.81	0.89	0.84	0.86
5.0	0.55	0.09	0.06	0.06	0.10	0.20	0.81	0.89	0.85	0.87
5.5	0.53	0.09	0.06	0.06	0.11	0.25	0.84	0.90	0.90	0.91
6.0	0.51	0.09	0.06	0.06	0.13	0.27	0.82	0.86	0.92	0.94
6.5	0.54	0.08	0.06	0.05	0.13	0.25	0.85	0.90	0.97	0.96
7.0	0.50	0.10	0.06	0.05	0.13	0.29	0.85	0.89	0.92	0.91
7.5	0.50	0.10	0.06	0.05	0.15	0.29	0.84	0.89	0.90	0.91
8.0	0.49	0.10	0.07	0.06	0.15	0.30	0.86	0.90	0.93	0.94
8.5	0.47	0.09	0.07	0.06	0.14	0.35	0.85	0.90	0.95	0.95
9.0	0.50	0.09	0.07	0.05	0.15	0.35	0.85	0.90	0.93	0.94
10.0	0.47	0.08	0.07	0.04	0.15	0.32	0.85	0.89	0.90	0.91
10.5	0.44	0.07	0.05	0.03	0.14	0.31	0.85	0.89	0.92	0.94
11.0	0.44	0.07	0.04	0.04	0.16	0.28	0.84	0.88	0.93	0.92
12.0	0.42	0.07	0.04	0.03	0.14	0.24	0.84	0.90	0.96	0.95
13.0	0.37	(0.07)	0.04	(0.03)	0.14	0.18	0.85	0.88	0.92	0.92
13.5	0.35	(0.07)	(0.04)	(0.03)	0.12	0.20	0.81	0.86	0.88	0.89

TABLE 137. NORMAL SPECTRAL EMISSIVITY ϵ CODE 201 THROUGH 210

CODE λ (μ) \	201	202	203	204	205	206	207	208	209	210
4.0	0.68	0.70	0.91	0.97	0.72	0.69	0.70	0.72	0.94	0.96
4.5	0.70	0.71	0.90	0.96	0.73	0.72	0.72	0.73	0.95	0.96
5.0	0.77	0.79	0.91	0.97	0.79	0.77	0.77	0.78	0.95	0.98
5.5	0.86	0.87	0.93	0.96	0.84	0.83	0.83	0.88	0.95	0.97
6.0	0.87	0.88	0.92	0.97	0.88	0.87	0.87	0.88	0.96	0.99
6.5	0.92	0.92	0.92	0.97	0.89	0.88	0.88	0.88	0.95	0.98
7.0	0.92	0.94	0.91	0.98	0.92	0.91	0.90	0.92	0.94	0.97
7.5	0.92	0.92	0.93	0.97	0.92	0.91	0.91	0.92	0.95	0.98
8.0	0.95	0.96	0.94	0.98	0.94	0.93	0.94	0.96	0.97	0.98
8.5	0.97	0.97	0.95	0.99	0.95	0.92	0.94	0.97	0.97	0.99
9.0	0.94	0.94	0.92	0.97	0.94	0.89	0.91	0.91	0.96	0.96
9.5	0.90	0.91	0.91	0.95	0.91	0.89	0.91	0.92	0.96	0.97
10.0	0.90	0.91	0.90	0.94	0.92	0.89	0.90	0.92	0.93	0.96
10.5	0.92	0.92	0.93	0.96	0.93	0.92	0.93	0.94	0.95	0.96
11.0	0.92	0.92	0.92	0.96	0.96	0.93	0.94	0.95	0.95	0.96
12.0	0.96	0.96	0.93	0.98	0.99	0.94	0.96	0.97	0.95	0.97
13.0	0.91	0.93	0.94	0.96	0.96	0.92	0.91	0.91	0.92	0.96
13.5	0.88	0.90	0.89	0.93	0.89	0.91	0.88	0.93	0.93	0.94

TABLE 138. NORMAL SPECTRAL EMISSIVITY ϵ CODE 211 THROUGH 220

λ (μ) \ CODE	211	212	213	214	215	216	217	218	219	220
4.0	0.93	0.95	0.93	0.97	0.91	0.97	0.96	0.94	0.93	0.96
4.5	0.93	0.95	0.96	0.97	0.92	0.96	0.95	0.94	0.92	0.94
4.0	0.94	0.96	0.94	0.98	0.93	0.97	0.95	0.96	0.93	0.97
5.5	0.95	0.95	0.95	0.96	0.94	0.96	0.95	0.97	0.93	0.97
6.0	0.94	0.98	0.93	0.97	0.93	0.96	0.95	0.97	0.93	0.99
6.5	0.94	0.98	0.93	0.98	0.93	0.96	0.95	0.98	0.91	0.99
7.0	0.95	0.97	0.93	0.99	0.91	0.95	0.95	0.96	0.91	0.96
7.5	0.96	0.98	0.94	0.97	0.92	0.95	0.96	0.96	0.91	0.97
8.0	0.97	0.98	0.97	0.99	0.93	0.96	0.98	0.99	0.94	0.99
8.5	0.98	0.99	0.98	0.99	0.95	0.97	0.99	0.99	0.96	0.99
9.0	0.95	0.96	0.94	0.98	0.92	0.94	0.98	0.98	0.94	0.99
9.5	0.93	0.95	0.93	0.96	0.91	0.94	0.98	0.96	0.93	0.97
10.0	0.93	0.95	0.92	0.96	0.90	0.92	0.95	0.95	0.92	0.96
10.5	0.96	0.98	0.96	0.98	0.92	0.93	0.98	0.96	0.94	0.98
11.0	0.97	0.97	0.96	0.98	0.90	0.93	0.97	0.98	0.93	0.98
12.0	0.98	0.99	0.97	0.99	0.91	0.93	0.97	0.98	0.93	0.97
13.0	0.96	0.98	0.95	0.98	0.92	0.93	0.94	0.95	0.91	0.95
13.5	0.95	0.94	0.94	0.97	0.89	0.92	0.94	0.94	0.89	0.93

TABLE 139. NORMAL SPECTRAL EMISSIVITY ϵ CODE 221 THROUGH 230

λ (μ) \ CODE	221	222	223	224	225	226	227	228	229	230
4.0	0.07	0.06	0.07	0.74	0.72	0.70	0.73	0.71	0.70	0.70
4.5	0.07	0.06	0.07	0.78	0.74	0.72	0.74	0.71	0.70	0.71
5.0	0.07	0.06	0.07	0.71	0.76	0.76	0.77	0.77	0.76	0.76
5.5	0.06	0.06	0.07	0.86	0.80	0.80	0.83	0.83	0.82	0.82
6.0	0.07	0.06	0.07	0.89	0.84	0.83	0.87	0.84	0.86	0.86
6.5	0.07	0.06	0.07	0.93	0.85	0.87	0.87	0.86	0.87	0.88
7.0	0.07	0.07	0.07	0.94	0.93	0.89	0.88	0.87	0.89	0.88
7.5	0.07	0.07	0.08	0.93	0.92	0.89	0.90	0.88	0.91	0.90
8.0	0.07	0.07	0.08	0.93	0.93	0.99	0.92	0.90	0.92	0.92
8.5	0.07	0.07	0.07	0.91	0.89	0.88	0.94	0.92	0.96	0.92
9.0	0.08	0.08	0.08	0.82	0.80	0.79	0.90	0.88	0.91	0.91
9.5	0.08	0.08	0.08	0.78	0.76	0.75	0.88	0.87	0.92	0.90
10.0	0.08	0.07	0.07	0.80	0.77	0.76	0.89	0.88	0.90	0.90
10.5	0.07	0.06	0.07	0.82	0.81	0.80	0.93	0.91	0.93	0.92
11.0	(0.07)	(0.06)	(0.07)	0.86	0.83	0.83	0.93	0.93	0.94	0.94
12.0	(0.07)	(0.06)	(0.07)	0.90	0.88	0.85	0.92	0.91	0.93	0.92
13.0	(0.07)	(0.06)	(0.07)	0.89	0.89	0.85	0.89	0.90	0.93	0.89
13.5	(0.07)	(0.06)	(0.07)	0.83	0.87	0.82	0.90	0.87	0.91	0.89

TABLE 140. NORMAL SPECTRAL EMISSIVITY ϵ CODE 231 THROUGH 240

λ (μ) \ CODE	231	232	233	234	235	236	237	238	239	240
4.0	0.73	0.74	0.72	0.74	0.78	0.74	0.69	0.72	0.09	0.09
4.5	0.75	0.74	0.75	0.76	0.81	0.79	0.74	0.75	0.09	0.09
5.0	0.79	0.80	0.80	0.80	0.85	0.83	0.79	0.81	0.09	0.09
5.5	0.84	0.84	0.83	0.85	0.88	0.86	0.82	0.84	0.08	0.09
6.0	0.87	0.88	0.88	0.88	0.92	0.90	0.87	0.89	0.09	0.09
6.5	0.90	0.88	0.88	0.89	0.93	0.91	0.87	0.89	0.08	0.09
7.0	0.90	0.91	0.90	0.92	0.95	0.91	0.89	0.90	0.09	0.09
7.5	0.91	0.91	0.91	0.92	0.95	0.94	0.91	0.91	0.09	0.09
8.0	0.92	0.92	0.93	0.92	0.95	0.94	0.92	0.93	0.09	0.10
8.5	0.94	0.94	0.94	0.95	0.99	0.97	0.94	0.95	0.09	0.09
9.0	0.91	0.91	0.94	0.95	0.96	0.96	0.94	0.94	0.10	0.10
9.5	0.91	0.91	0.93	0.94	0.96	0.94	0.93	0.93	0.10	0.10
10.0	0.91	0.90	0.91	0.92	0.94	0.95	0.92	0.92	0.10	0.10
10.5	0.92	0.90	0.95	0.95	0.95	0.93	0.94	0.94	0.09	0.10
11.0	0.94	0.92	0.94	0.97	0.98	0.96	0.93	0.94	0.09	0.09
12.0	0.93	0.92	0.93	0.94	0.95	0.95	0.91	0.95	(0.09)	(0.09)
13.0	0.93	0.93	0.83	0.87	0.87	0.87	0.82	0.88	(0.09)	(0.09)
13.5	0.86	0.92	0.86	0.88	0.91	0.87	0.82	0.85	(0.09)	(0.09)

TABLE 141. NORMAL SPECTRAL EMISSIVITY ϵ CODE 241 THROUGH 250

λ (μ) \ CODE	241	242	243	244	245	246	247	248	249	250
4.0	0.08	0.08	0.26	0.25	0.27	0.27				
4.5	0.08	0.08	0.25	0.25	0.27	0.26	0.26	0.24	0.28	0.28
5.0	0.08	0.08	0.25	0.25	0.27	0.26	0.25	0.23	0.26	0.25
5.5	0.08	0.08	0.25	0.24	0.26	0.26				
6.0	0.08	0.08	0.25	0.24	0.26	0.25	0.22	0.22	0.24	0.24
6.5	0.07	0.08	0.22	0.23	0.25	0.25				
7.0	0.08	0.09	0.24	0.24	0.25	0.24	0.23	0.21	0.26	0.26
7.5	0.08	0.09	0.23	0.24	0.24	0.24				
8.0	0.09	0.09	0.25	0.24	0.26	0.26	0.24	0.22	0.26	0.25
8.5	0.08	0.09	0.25	0.25	0.26	0.26				
9.0	0.09	0.09	0.26	0.25	0.25	0.26	0.24	0.24	0.26	0.26
9.5	0.09	0.09	0.24	0.24	0.24	0.25				
10.0	0.09	0.09	0.24	0.24	0.23	0.24	0.22	0.20	0.26	0.22
10.5	0.09	0.09	0.23	0.22	0.23	0.23				
11.0	0.09	0.08	0.22	0.22	0.21	0.22	0.20	0.18	0.22	0.20
12.0	(0.09)	(0.08)	0.21	0.22	0.22	0.20				
13.0	(0.09)	(0.08)	0.23	0.22	0.21	0.23				
13.5	(0.09)	(0.08)	0.23	0.22	0.21	0.23				

TABLE 142. NORMAL SPECTRAL EMISSIVITY ϵ CODE 251 THROUGH 260

TABLE 143. NORMAL SPECTRAL EMISSIVITY ϵ CODE 261 THROUGH 270

λ (μ) \ CODE	261	262	263	264	265	266	267	268	269	270
4.0					0.35	0.35	0.07	0.07	0.31	0.30
4.5	0.27	0.27	0.27	0.27	0.36	0.36	0.07	0.08	0.30	0.28
5.0	0.23	0.25	0.27	0.27	0.36	0.35	0.08	0.08	0.29	0.29
5.5					0.35	0.35	0.07	0.08	0.28	0.27
6.0	0.23	0.23	0.25	0.23	0.35	0.35	0.08	0.08	0.27	0.27
6.5					0.33	0.34	0.07	0.07	0.28	0.27
7.0	0.24	0.23	0.27	0.27	0.33	0.33	0.08	0.08	0.28	0.27
7.5					0.33	0.34	0.08	0.08	0.28	0.28
8.0	0.23	0.24	0.27	0.27	0.34	0.34	0.08	0.09	0.29	0.27
8.5					0.35	0.36	0.07	0.08	0.29	0.28
9.0	0.22	0.25	0.26	0.26	0.36	0.37	0.08	0.10	0.29	0.29
9.5					0.34	0.35	0.08	0.09	0.29	0.28
10.0	0.21	0.21	0.25	0.25	0.31	0.32	0.08	0.09	0.28	0.27
10.5					0.31	0.32	0.08	0.09	0.27	0.27
11.0	0.19	0.19	0.20	0.20	0.31	0.32	0.07	0.07	0.26	0.25
12.0					0.30	0.30	(0.07)	(0.07)	0.27	0.25
13.0					0.28	0.28	(0.07)	(0.07)	0.25	0.23
13.5					0.27	0.27	(0.07)	(0.07)	0.22	0.23

TABLE 144. NORMAL SPECTRAL EMISSIVITY ϵ CODE 271 THROUGH 280

CODE λ (μ) \	271	272	273	274	275	276	277	278	279	280
4.0	0.35	0.35	0.06	0.06	0.06	0.06	0.43	0.44	0.49	0.56
4.5	0.34	0.36	0.06	0.07	0.07	0.06	0.43	0.43	0.43	0.57
5.0	0.34	0.35	0.07	0.08	0.07	0.07	0.43	0.42	0.46	0.57
5.5	0.34	0.34	0.07	0.08	0.07	0.07	0.42	0.41	0.45	0.56
6.0	0.34	0.35	0.06	0.08	0.07	0.07	0.43	0.42	0.45	0.56
6.5	0.33	0.35	0.06	0.08	0.08	0.06	0.48	0.48	0.49	0.63
7.0	0.33	0.34	0.07	0.08	0.08	0.07	0.49	0.48	0.52	0.69
7.5	0.33	0.35	0.08	0.09	0.08	0.08	0.43	0.43	0.47	0.65
8.0	0.35	0.37	0.08	0.09	0.08	0.08	0.43	0.40	0.45	0.60
8.5	0.35	0.36	0.07	0.08	0.08	0.07	0.42	0.41	0.43	0.58
9.0	0.34	0.38	0.08	0.09	0.08	0.07	0.41	0.41	0.45	0.59
9.5	0.35	0.38	0.07	0.08	0.08	0.08	0.41	0.40	0.43	0.57
10.0	0.31	0.36	0.07	0.08	0.08	0.07	0.42	0.40	0.43	0.58
10.5	0.31	0.34	0.06	0.08	0.07	0.07	0.41	0.40	0.43	0.57
11.0	0.32	0.33	0.06	0.07	0.07	0.07	0.39	0.38	0.44	0.56
12.0	0.31	0.32	(0.06)	(0.07)	(0.07)	(0.07)	0.39	0.37	0.41	0.57
13.0	0.29	0.29	(0.06)	(0.07)	(0.07)	(0.07)	0.37	0.34	0.41	0.51
13.5	0.27	0.29	(0.06)	(0.07)	(0.07)	(0.07)	0.36	0.36	0.41	0.49

TABLE 145. NORMAL SPECTRAL EMISSIVITY ϵ CODE 281 THROUGH 290

CODE λ (μ) \	281	282	283	284	285	286	287	288	289	290
4.0	0.57	0.53	0.22	0.22	0.23	0.40	0.45	0.39	0.54	0.61
4.5	0.55	0.53	0.20	0.22	0.21	0.37	0.42	0.38	0.56	0.61
5.0	0.53	0.52	0.19	0.20	0.20	0.36	0.41	0.38	0.62	0.65
5.5	0.53	0.52	0.18	0.18	0.18	0.35	0.39	0.36	0.72	0.75
6.0	0.53	0.51	0.20	0.20	0.21	0.42	0.45	0.48	0.88	0.90
6.5	0.61	0.57	0.24	0.21	0.21	0.63	0.61	0.68	0.96	0.95
7.0	0.69	0.63	0.26	0.21	0.22	0.78	0.74	0.79	0.97	0.97
7.5	0.62	0.59	0.19	0.17	0.18	0.47	0.50	0.50	0.98	0.99
8.0	0.58	0.55	0.17	0.16	0.17	0.34	0.38	0.37	0.98	0.98
8.5	0.55	0.52	0.16	0.15	0.16	0.33	0.35	0.34	0.98	0.99
9.0	0.57	0.53	0.15	0.15	0.16	0.33	0.34	0.34	0.99	0.99
9.5	0.56	0.52	0.14	0.15	0.14	0.31	0.33	0.32	0.99	0.99
10.0	0.55	0.52	0.14	0.14	0.14	0.29	0.32	0.33	0.99	0.99
10.5	0.54	0.51	0.13	0.13	0.14	0.29	0.33	0.33	0.77	0.77
11.0	0.54	0.52	0.13	0.12	0.12	0.24	0.27	0.26	0.70	0.70
12.0	0.54	0.49	0.11	0.11	0.11	0.21	0.22	0.22	0.72	0.73
13.0	0.51	0.49	0.11	0.11	0.11	0.21	0.22	0.22	0.74	0.77
13.5	0.48	0.46	0.11	0.11	0.11	0.21	0.22	0.22	0.74	0.72

TABLE 146. NORMAL SPECTRAL EMISSIVITY ϵ CODE 291 THROUGH 300

λ (μ) \ CODE	291	292	293	294	295	296	297	298	299	300
4.0	0.38	0.41	0.53	0.51	0.48	0.52	0.60	0.61	0.87	0.03
4.5	0.38	0.41	0.56	0.56	0.50	0.54	0.73	0.72	0.90	0.04
5.0	0.43	0.46	0.63	0.63	0.53	0.58	0.89	0.89	0.91	0.05
5.5	0.50	0.52	0.75	0.74	0.58	0.62	0.95	0.96	0.92	0.05
6.0	0.62	0.62	0.91	0.89	0.69	0.71	0.94	0.96	0.94	0.05
6.5	0.71	0.71	0.96	0.95	0.77	0.79	0.95	0.97	0.94	0.03
7.0	0.80	0.78	0.98	0.95	0.86	0.87	0.97	0.98	0.95	0.05
7.5	0.86	0.86	0.98	0.96	0.90	0.93	0.99	0.99	0.93	0.06
8.0	0.93	0.91	0.99	0.98	0.95	0.97	0.99	0.99	0.84	0.06
8.5	0.94	0.94	0.99	0.99	0.96	0.98	0.96	0.97	0.80	0.06
9.0	0.98	0.97	0.99	0.99	0.99	0.99	0.92	0.93	0.77	0.05
9.5	0.99	0.97	0.99	0.99	0.99	0.99	0.93	0.93	0.87	0.04
10.0	0.99	0.98	0.99	0.98	0.99	0.99	0.96	0.96	0.89	0.03
10.5	0.98	0.98	0.83	0.81	0.99	0.99	0.95	0.96	0.88	
11.0	0.99	0.98	0.78	0.76	0.99	0.96	0.95	0.98	0.91	
12.0	0.99	0.99	0.78	0.76	0.99	0.99	0.97	0.98	0.91	
13.0	0.97	0.97	0.73	0.74	0.96	0.98	0.95	0.96	0.87	
13.5	0.92	0.97	0.79	0.74	0.94	0.94	0.95	0.93	0.87	

TABLE 147. NORMAL SPECTRAL EMISSIVITY ϵ CODE 301 THROUGH 310

λ (μ) \ CODE	301	302	303	304	305	306	307	308	309	310
4.0	0.17	0.07	0.14	0.04	0.31	0.34	0.37	0.42	0.43	0.45
4.5	0.17	0.09	0.16	0.04	0.33	0.38	0.39	0.44	0.44	0.44
5.0	0.20	0.10	0.15	0.05	0.31	0.47	0.48	0.49	0.50	0.43
5.5	0.18	0.09	0.14	0.04	0.28	0.59	0.60	0.59	0.60	0.43
6.0	0.17	0.07	0.11	0.03	0.24	0.76	0.76	0.78	0.79	0.45
6.5	0.15	0.05	0.08	0.03	0.20	0.82	0.82	0.87	0.89	0.46
7.0	0.16	0.07	0.10	0.04	0.20	0.86	0.87	0.91	0.93	0.44
7.5	0.18	0.08	0.11	0.05	0.21	0.89	0.89	0.92	0.94	0.43
8.0	0.17	0.08	0.10	0.05	0.16	0.91	0.91	0.94	0.96	0.41
8.5	0.16	0.07	0.09	0.05	0.16	0.93	0.93	0.96	0.97	0.42
9.0	0.14	0.05	0.07	0.03	0.15	0.94	0.94	0.96	0.98	0.43
9.5	0.13	0.04	0.06	0.04	0.12	0.93	0.94	0.97	0.98	0.41
10.0	0.11	0.04	0.05		0.09	0.91	0.91	0.95	0.96	0.39
10.5	0.09		0.03		0.07	0.77	0.76	0.80	0.81	0.37
11.0	0.07		0.03		0.06	0.70	0.70	0.72	0.74	0.38
12.0	0.05				0.04	0.71	0.70	0.74	0.74	0.37
13.0						0.72	0.72	0.77	0.76	0.34
13.5						0.67	0.67	0.72	0.72	0.34

TABLE 148. NORMAL SPECTRAL EMISSIVITY ϵ CODE 311 THROUGH 320

CODE λ (μ) \	311	312	313	314	315	316	317	318	319	320
4.0	0.48	0.46	0.34	0.78	0.78	0.40	0.39	0.76	0.76	0.83
4.5	0.46	0.44	0.39	0.78	0.80	0.36	0.35	0.75	0.74	0.84
5.0	0.46	0.49	0.46	0.79	0.79	0.34	0.33	0.76	0.75	0.85
5.5	0.45	0.59	0.58	0.76	0.78	0.31	0.30	0.79	0.78	0.84
6.0	0.47	0.79	0.75	0.82	0.83	0.38	0.37	0.82	0.81	0.87
6.5	0.47	0.86	0.82	0.83	0.84	0.36	0.35	0.84	0.84	0.86
7.0	0.47	0.89	0.86	0.86	0.88	0.32	0.32	0.87	0.86	0.89
7.5	0.46	0.91	0.87	0.90	0.91	0.33	0.32	0.87	0.86	0.90
8.0	0.44	0.93	0.89	0.95	0.95	0.51	0.50	0.91	0.91	0.94
8.5	0.45	0.95	0.91	0.94	0.96	0.84	0.83	0.93	0.94	0.97
9.0	0.44	0.95	0.92	0.93	0.93	0.93	0.91	0.90	0.91	0.96
9.5	0.44	0.96	0.93	0.92	0.91	0.93	0.90	0.89	0.89	0.93
10.0	0.42	0.93	0.89	0.92	0.91	0.88	0.87	0.88	0.87	0.91
10.5	0.40	0.78	0.76	0.92	0.92	0.82	0.80	0.91	0.90	0.94
11.0	0.41	0.72	0.69	0.92	0.92	0.70	0.70	0.92	0.93	0.95
12.0	0.40	0.73	0.70	0.94	0.95	0.56	0.55	0.93	0.95	0.97
13.0	0.37	0.75	0.71	0.96	0.96	0.48	0.46	0.90	0.92	0.91
13.5	0.35	0.70	0.66	0.92	0.92	0.50	0.47	0.86	0.87	0.89

TABLE 149. NORMAL SPECTRAL EMISSIVITY ϵ CODE 321 THROUGH 330

λ (μ) \ CODE	321	322	323	324	325	326	327	328	329	330
4.0	0.84	0.83	0.82	0.67	0.66	0.60	0.61	0.35	0.56	0.59
4.5	0.83	0.85	0.81	0.64	0.63	0.60	0.60	0.37	0.52	0.54
5.0	0.84	0.84	0.83	0.66	0.66	0.62	0.63	0.44	0.54	0.55
5.5	0.84	0.85	0.84	0.68	0.68	0.67	0.67	0.55	0.62	0.63
6.0	0.87	0.85	0.85	0.70	0.70	0.73	0.73	0.73	0.76	0.79
6.5	0.87	0.87	0.86	0.76	0.75	0.76	0.76	0.82	0.83	0.87
7.0	0.88	0.87	0.86	0.80	0.79	0.80	0.80	0.87	0.88	0.90
7.5	0.89	0.89	0.88	0.80	0.80	0.81	0.80	0.85	0.89	0.92
8.0	0.93	0.90	0.90	0.82	0.82	0.88	0.86	0.90	0.91	0.93
8.5	0.95	0.91	0.91	0.86	0.87	0.92	0.89	0.92	0.92	0.95
9.0	0.93	0.90	0.89	0.87	0.87	0.91	0.88	0.93	0.91	0.94
9.5	0.92	0.88	0.87	0.86	0.86	0.89	0.87	0.94	0.92	0.94
10.0	0.90	0.87	0.88	0.86	0.86	0.88	0.87	0.88	0.85	0.89
10.5	0.93	0.91	0.91	0.86	0.86	0.90	0.87	0.69	0.69	0.71
11.0	0.95	0.91	0.90	0.82	0.85	0.90	0.87	0.64	0.63	0.67
12.0	0.96	0.91	0.91	0.88	0.88	0.93	0.91	0.63	0.60	0.66
13.0	0.91	0.88	0.87	0.82	0.85	0.86	0.86	0.61	0.61	0.64
13.5	0.87	0.85	0.84	0.82	0.82	0.86	0.86	0.69	0.68	0.69

TABLE 150. NORMAL SPECTRAL EMISSIVITY ϵ CODE 331 THROUGH 340

λ (μ) \ CODE	331	332	333	334	335	336	337	338	339	340
4.0	0.38	0.39	0.37	0.41	0.59	0.62	0.50	0.80	0.67	0.67
4.5	0.41	0.41	0.38	0.45	0.58	0.61	0.58	0.88	0.64	0.65
5.0	0.46	0.46	0.45	0.51	0.61	0.65	0.65	0.90	0.65	0.65
5.5	0.56	0.56	0.56	0.61	0.66	0.71	0.69	0.92	0.73	0.72
6.0	0.74	0.74	0.75	0.76	0.71	0.75	0.76	0.87	0.78	0.78
6.5	0.83	0.81	0.83	0.84	0.76	0.78	0.78	0.77	0.83	0.83
7.0	0.86	0.85	0.86	0.86	0.77	0.80	0.72	0.68	0.85	0.85
7.5	0.89	0.86	0.88	0.88	0.78	0.81	0.65	0.54	0.86	0.86
8.0	0.91	0.87	0.90	0.89	0.85	0.87	0.59	0.46	0.89	0.91
8.5	0.94	0.90	0.92	0.92	0.88	0.89	0.51	0.48	0.91	0.93
9.0	0.93	0.89	0.91	0.92	0.88	0.90	0.47	0.40	0.92	0.89
9.5	0.93	0.89	0.92	0.91	0.86	0.88	0.43	0.38	0.87	0.88
10.0	0.88	0.86	0.87	0.87	0.85	0.87	0.38	0.30	0.86	0.86
10.5	0.69	0.69	0.68	0.71	0.86	0.88	0.35	0.27	0.90	0.90
11.0	0.64	0.64	0.64	0.67	0.89	0.89	0.31	0.23	0.90	0.92
12.0	0.64	0.63	0.64	0.69	0.90	0.91	0.23	0.19	0.94	0.96
13.0	0.61	0.62	0.63	0.65	0.85	0.89	0.17	0.13	0.90	0.91
13.5	0.67	0.61	0.61	0.60	0.86	0.87	0.13	0.12	0.87	0.85

TABLE 151. NORMAL SPECTRAL EMISSIVITY ϵ CODE 341 THROUGH 350

λ (μ) \ CODE	341	342	343	344	345	346	347	348	349	350
4.0	0.70	0.74	0.72	0.71	0.65	0.67	0.71	0.70	0.71	0.71
4.5	0.62	0.68	0.64	0.64	0.61	0.63	0.66	0.64	0.64	0.66
5.0	0.65	0.71	0.68	0.68	0.63	0.65	0.69	0.66	0.70	0.70
5.5	0.74	0.75	0.75	0.74	0.68	0.69	0.73	0.71	0.71	0.72
6.0	0.80	0.81	0.81	0.80	0.75	0.75	0.78	0.77	0.77	0.78
6.5	0.85	0.85	0.85	0.83	0.80	0.81	0.82	0.81	0.78	0.80
7.0	0.88	0.88	0.88	0.86	0.82	0.82	0.84	0.84	0.86	0.86
7.5	0.90	0.89	0.89	0.88	0.84	0.84	0.86	0.86	0.88	0.88
8.0	0.91	0.91	0.91	0.92	0.89	0.91	0.90	0.90	0.93	0.93
8.5	0.93	0.93	0.92	0.91	0.93	0.94	0.92	0.92	0.95	0.96
9.0	0.89	0.90	0.90	0.87	0.91	0.91	0.91	0.91	0.92	0.92
9.5	0.87	0.89	0.88	0.87	0.88	0.89	0.90	0.90	0.90	0.91
10.0	0.87	0.88	0.89	0.86	0.88	0.88	0.90	0.90	0.91	0.92
10.5	0.91	0.92	0.91	0.88	0.91	0.92	0.92	0.92	0.94	0.94
11.0	0.92	0.93	0.93	0.92	0.93	0.93	0.93	0.93	0.95	0.96
12.0	0.94	0.95	0.95	0.93	0.95	0.96	0.94	0.95	0.97	0.97
13.0	0.92	0.90	0.91	0.91	0.90	0.90	0.89	0.89	0.90	0.90
13.5	0.88	0.89	0.88	0.90	0.89	0.88	0.88	0.88	0.83	0.84

TABLE 152. NORMAL SPECTRAL EMISSIVITY ϵ CODE 351 THROUGH 360

λ (μ) \ CODE	351	352	353	354	355	356	357	358	359	360
4.0	0.72	0.72	0.74	0.75	0.72	0.71	0.70	0.67	0.61	0.63
4.5	0.66	0.66	0.67	0.68	0.66	0.67	0.64	0.60	0.59	0.59
5.0	0.68	0.69	0.71	0.71	0.67	0.68	0.66	0.63	0.62	0.63
5.5	0.72	0.73	0.73	0.74	0.71	0.72	0.72	0.68	0.68	0.70
6.0	0.79	0.78	0.78	0.79	0.77	0.78	0.80	0.74	0.75	0.78
6.5	0.82	0.82	0.82	0.82	0.79	0.79	0.85	0.79	0.81	0.82
7.0	0.84	0.85	0.85	0.86	0.81	0.82	0.88	0.82	0.83	0.84
7.5	0.88	0.87	0.89	0.89	0.84	0.85	0.89	0.85	0.83	0.83
8.0	0.93	0.93	0.92	0.93	0.90	0.92	0.96	0.92	0.88	0.89
8.5	0.94	0.94	0.95	0.95	0.93	0.93	0.97	0.92	0.91	0.91
9.0	0.93	0.93	0.93	0.94	0.92	0.92	0.95	0.90	0.89	0.92
9.5	0.93	0.93	0.91	0.91	0.91	0.91	0.92	0.87	0.87	0.89
10.0	0.92	0.91	0.91	0.92	0.90	0.90	0.91	0.86	0.88	0.89
10.5	0.95	0.96	0.94	0.95	0.93	0.93	0.93	0.88	0.90	0.91
11.0	0.96	0.96	0.96	0.97	0.95	0.96	0.95	0.89	0.89	0.90
12.0	0.98	0.99	0.97	0.98	0.95	0.97	0.95	0.94	0.91	0.93
13.0	0.90	0.92	0.89	0.89	0.88	0.88	0.92	0.90	0.92	0.93
13.5	0.85	0.85	0.77	0.80	0.80	0.80	0.94	0.92	0.86	0.88

TABLE 153. NORMAL SPECTRAL EMISSIVITY ϵ CODE 361 THROUGH 370

CODE λ (μ) \	361	362	363	364	365	366	367	368	369	370
4.0	0.73	0.73	0.64	0.67	0.67	0.64	0.69	0.67	0.74	0.71
4.5	0.69	0.69	0.61	0.61	0.63	0.59	0.65	0.64	0.78	0.72
5.0	0.72	0.72	0.65	0.66	0.66	0.61	0.66	0.66	0.79	0.74
5.5	0.74	0.76	0.71	0.71	0.71	0.66	0.75	0.74	0.82	0.80
6.0	0.80	0.82	0.76	0.75	0.76	0.71	0.85	0.82	0.85	0.83
6.5	0.86	0.87	0.78	0.78	0.82	0.74	0.91	0.88	0.87	0.83
7.0	0.89	0.88	0.82	0.82	0.85	0.79	0.91	0.90	0.87	0.85
7.5	0.88	0.87	0.86	0.86	0.87	0.82	0.90	0.89	0.87	0.84
8.0	0.90	0.90	0.90	0.91	0.92	0.89	0.94	0.93	0.91	0.88
8.5	0.90	0.90	0.91	0.91	0.93	0.90	0.95	0.93	0.93	0.90
9.0	0.90	0.91	0.91	0.91	0.93	0.89	0.92	0.93	0.93	0.89
9.5	0.91	0.91	0.88	0.89	0.92	0.88	0.91	0.91	0.89	0.87
10.0	0.91	0.90	0.89	0.90	0.91	0.88	0.90	0.91	0.89	0.87
10.5	0.92	0.92	0.92	0.93	0.92	0.87	0.91	0.91	0.89	0.87
11.0	0.92	0.91	0.91	0.92	0.93	0.90	0.94	0.93	0.93	0.89
12.0	0.94	0.94	0.91	0.92	0.93	0.89	0.92	0.96	0.96	0.90
13.0	0.90	0.91	0.89	0.89	0.94	0.89	0.94	0.94	0.93	0.90
13.5	0.83	0.80	0.77	0.77	0.86	0.79	0.95	0.96	0.89	0.86

TABLE 154. NORMAL SPECTRAL EMISSIVITY ϵ CODE 371 THROUGH 380

λ (μ) \ CODE	371	372	373	374	375	376	377	378	379	380
4.0	0.77	0.75	0.70	0.71	0.77	0.76	0.75	0.72	0.87	0.87
4.5	0.77	0.73	0.66	0.68	0.78	0.75	0.68	0.68	0.82	0.83
5.0	0.77	0.73	0.69	0.71	0.77	0.76	0.70	0.70	0.84	0.84
5.5	0.78	0.74	0.73	0.74	0.80	0.80	0.76	0.76	0.88	0.88
6.0	0.83	0.79	0.76	0.77	0.84	0.84	0.84	0.85	0.94	0.92
6.5	0.88	0.86	0.80	0.80	0.91	0.90	0.93	0.93	0.99	0.96
7.0	0.92	0.88	0.83	0.82	0.91	0.90	0.92	0.94	0.93	0.91
7.5	0.92	0.90	0.84	0.85	0.91	0.91	0.92	0.93	0.92	0.91
8.0	0.94	0.91	0.91	0.91	0.93	0.93	0.93	0.93	0.93	0.94
8.5	0.94	0.90	0.93	0.92	0.92	0.93	0.95	0.94	0.96	0.96
9.0	0.95	0.92	0.91	0.91	0.93	0.93	0.93	0.93	0.95	0.94
9.5	0.93	0.91	0.89	0.89	0.93	0.93	0.93	0.92	0.95	0.93
10.0	0.94	0.91	0.90	0.89	0.93	0.93	0.94	0.94	0.95	0.94
10.5	0.91	0.88	0.89	0.88	0.90	0.90	0.96	0.95	0.94	0.93
11.0	0.96	0.93	0.92	0.92	0.93	0.92	0.97	0.97	0.94	0.93
12.0	0.97	0.93	0.92	0.95	0.95	0.95	0.98	0.98	0.97	0.95
13.0	0.90	0.87	0.92	0.93	0.92	0.91	0.88	0.89	0.92	0.91
13.5	0.86	0.81	0.86	0.86	0.87	0.86	0.86	0.83	0.89	0.90

TABLE 155. NORMAL SPECTRAL EMISSIVITY ϵ CODE 381 THROUGH 390

CODE λ (μ)\diag	381	382	383	384	385	386	387	388	389	390
4.0	0.82	0.75	0.56	0.56	(0.85)	(0.91)	(0.84)	(0.89)	0.07	0.10
4.5	0.89	0.62	0.55	0.57	(0.85)	(0.91)	(0.84)	(0.89)	0.11	0.13
5.0	0.96	0.57	0.56	0.56	(0.85)	(0.91)	(0.84)	(0.89)	0.11	0.14
5.5	0.98	0.53	0.55	0.54	(0.85)	(0.91)	(0.84)	(0.89)	0.11	0.14
6.0	0.99	0.57	0.55	0.54	(0.85)	(0.91)	(0.84)	90.89	0.12	0.14
6.5	0.91	0.60	0.55	0.53	0.85	0.91	0.84	0.89	0.10	0.13
7.0	0.79	0.67	0.52	0.52	0.86	0.90	0.85	0.89	0.10	0.12
7.5	0.67	0.70	0.51	0.52	0.86	0.90	0.86	0.89	0.09	0.11
8.0	0.58	0.80	0.53	0.52	0.85	0.90	0.86	0.91	0.12	0.15
8.5	0.50	0.83	0.52	0.51	0.87	0.84	0.88	0.84	0.23	0.27
9.0	0.44	0.86	0.52	0.50	0.86	0.74	0.86	0.73	0.34	0.37
9.5	0.39	0.86	0.50	0.49	0.83	0.70	0.83	0.69	0.59	0.62
10.0	0.35	0.90	0.47	0.48	0.82	0.73	0.82	0.72	0.63	0.63
10.5	0.32	0.91	0.45	0.46	0.86	0.80	0.85	0.80	0.40	0.41
11.0	0.28	0.90	0.44	0.44	0.86	0.81	0.84	0.81	0.26	0.28
12.0	0.22	0.85	0.43	0.43	0.87	0.85	0.87	0.84	0.14	0.17
13.0	0.17	0.74	0.38	0.40	0.88	0.87	0.87	0.88	0.13	0.13
13.5		0.72	0.35	0.35	0.81	0.83	0.85	0.83	(0.13)	(0.13)

TABLE 156. NORMAL SPECTRAL EMISSIVITY ϵ CODE 391 THROUGH 396

CODE λ (μ) \diagdown	391	392	393	394	395	396				
4.0	0.15	0.20	0.83	0.86	0.85	0.18				
4.5	0.19	0.23	0.75	0.75	0.76	0.24				
5.0	0.20	0.25	0.66	0.67	0.68	0.29				
5.5	0.22	0.24	0.60	0.61	0.61	0.36				
6.0	0.20	0.24	0.53	0.55	0.55	0.43				
6.5	0.19	0.22	0.48	0.50	0.49	0.47				
7.0	0.17	0.21	0.45	0.51	0.48	0.50				
7.5	0.18	0.22	0.43	0.50	0.46	0.52				
8.0	0.23	0.27	0.40	0.45	0.43	0.55				
8.5	0.34	0.38	0.38	0.44	0.41	0.54				
9.0	0.46	0.45	0.37	0.41	0.40	0.53				
9.5	0.48	0.61	0.37	0.41	0.39	0.52				
10.0	0.62	0.58	0.35	0.39	0.37	0.55				
10.5	0.44	0.45	0.33	0.36	0.35	0.57				
11.0	0.32	0.35	0.31	0.35	0.33	0.59				
12.0	0.22	0.28	0.30	0.38	0.34	0.62				
13.0	0.20	0.26	0.26	0.31	0.29	0.66				
13.5	(0.20)	0.24	0.27	0.27	0.27	0.66				

TABLE 157. NORMAL SPECTRAL EMISSIVITY ϵ CODE 397 THROUGH 403

TABLE 158. NORMAL SPECTRAL EMISSIVITY ϵ CODE 404 THROUGH 409

TABLE 159. NORMAL SPECTRAL EMISSIVITY ϵ CODE 410 THROUGH 416

TABLE 160. NORMAL SPECTRAL EMISSIVITY ϵ CODE 417 THROUGH 424

CODE λ (μ) \ 417	417	418	419	420	421	422		423	424	
4.0	0.51	0.52	0.52	0.54	0.51	0.37		0.98	0.98	
4.5	0.55	0.54	0.57	0.58	0.57	0.43		0.99	0.99	
5.0	0.58	0.58	0.58	0.61	0.59	0.45		0.99	0.99	
5.5	0.63	0.60	0.61	0.63	0.60	0.47		0.99	0.99	
6.0	0.57	0.56	0.56	0.59	0.55	0.42		0.99	0.99	
6.5	0.56	0.55	0.56	0.58	0.55	0.42		0.98	0.98	
7.0	0.60	0.57	0.57	0.61	0.57	0.44		0.99	0.99	
7.5	0.55	0.53	0.53	0.55	0.54	0.42		0.99	0.99	
8.0	0.53	0.51	0.52	0.54	0.54	0.40		0.99	0.97	
8.5	0.53	0.52	0.53	0.54	0.53	0.41		0.97	0.95	
9.0	0.51	0.50	0.51	0.54	0.53	0.42		0.96	0.94	
9.5	0.48	0.49	0.49	0.50	0.51	0.39		0.96	0.95	
10.0	0.49	0.50	0.51	0.53	0.52	0.40		0.98	0.97	
10.5	0.46	0.47	0.48	0.49	0.50	0.36		0.95	0.95	
11.0	0.44	0.45	0.48	0.49	0.48	0.33		0.91	0.91	
12.0	0.39	0.42	0.42	0.44	0.43	0.30		0.83	0.85	
13.0	0.39	0.39	0.41	0.41	0.40	0.26		0.81	0.82	
13.5	0.37	0.37	0.44	0.44	0.40			0.79	0.85	

TABLE 161. NORMAL SPECTRAL EMISSIVITY ϵ CODE 425 THROUGH 434

CODE λ (μ) \	425	426	427	428	429	430	431	432	433	434
4.0	8	9	26	26	99	99	88	86	90	95
4.5	8	9	22	23	97	99	92	91	98	99
5.0	7	9	20	21	88	91	97	97	99	99
5.5	6	7	14	14	72	73	98	98	99	99
6.0	4	5	10	10	46	47	96	96	86	87
6.5	3	4	8	8	37	37	97	97	73	74
7.0	3	4	8	7	29	29	98	98	65	66
7.5	2	3	6	6	22	22	98	98	59	61
8.0			5	5	17	17	94	96	55	58
8.5			4	4	13	18	92	97	57	60
9.0			4	4	10	10	88	91	59	63
9.5					9	9	84	87	62	65
10.0					9	7	77	81	67	68
10.5					7	6	69	74	69	70
11.0							66	69	69	71
12.0							51	56	77	79
13.0							34	36	85	89
13.5							31	31	89	89

APPENDIX
DESCRIPTION OF INSTRUMENTATION

Excerpts from Final Technical Report by
R. McDonough and submitted by Baird-Atomic,
Incorporated, Cambridge, Massachusetts,
29 July 1960.

INSTRUMENTATION

This section describes measurements made under this contract and the instruments used to make these measurements. The first four measurements are made on a routine basis. The other measurements described are those that have been made occasionally when it was thought they would provide additional useful information.

A. HEMISPHERICAL SPECTRAL REFLECTANCE, 0.4 TO 0.7 MICRON

This measurement is made by Color Measurements Laboratory of M. I. T. on a General Electric recording spectrophotometer with an integrating sphere attachment. This is a double-beam instrument using a carefully prepared surface of MgO as a 100 percent diffuse reflectance standard. A collimated beam of light is incident on the sample at an angle of 6 degrees from the normal with all reflected energy, both specular and diffuse, being measured. A detailed description of this instrument may be found in the literature.*

B. HEMISPHERICAL SPECTRAL REFLECTANCE, 1.0 TO 3.5 MICRONS

The instrument for this measurement is an integrating sphere designed and constructed under this contract. It should be noted that although this is an integrating sphere device it differs from those commonly used in the visible by employing diffuse illumination of the sample.

1. Theory. The use of integrating spheres in the visible and near infrared up to about 2.5 microns for the measurement of reflectance is a standard method. The recent development of lead selenide detectors provides an opportunity to extend the method to 4 microns. However, beyond 2.5 microns, a diffuse reflectance standard must be calibrated before reflectance measurements can be made. The method of making an absolute measurement of diffuse reflectance requires the measurement of sphere wall brightness when a complete sphere and a partial sphere are used. With a design due to Preston, reflectance of the wall coating of an integrating sphere can be determined. Then, the same sphere can be used to measure the reflectance of other samples. The following discussion of the theory of such a sphere is essentially that given by Preston.**

* A. C. Hardy, Jour. Opt. Soc. America 25, 305 (1935).

** J. S. Preston, Trans. Opt. Soc (London) 31, 15 (1929-30).

For convenience, a theorem used in the derivation will be stated first. Consider a sphere of radius, R , and total wall area of $S = 4\pi R^2$ and a uniform wall brightness, b . Assume there are two apertures with zero reflectance having plane areas A and B and cutting off spherical areas A_s and B_s . The total flux lost through the two apertures is:

Flux lost = Flux that would go to A if the rest of the sphere were present.
 + Flux that would go to B if the rest of the sphere were present.
 - Flux that would go out A originating from a spherical cap equal to B_s .
 - Flux that would go out B originating from a spherical cap equal to A_s .

$$= \pi b A + \pi b B - \pi b \frac{A_s}{S} B_s - \pi b \frac{B_s}{S} A_s$$

$$\text{Flux lost} = \pi b (A + B) - 2\pi b \frac{A_s B_s}{S}$$

The Preston sphere is shown in Figure 1. The two small apertures are used for illumination and observation; a collimated beam of light entering one aperture and illuminating a portion of the sphere wall and a detector at the other aperture measuring the brightness of another portion of the sphere wall. The large test aperture is shown with a flat plate which has the same coating as the rest of the sphere wall. Measurements are made with this plate in place and also when the plate is replaced by a black body which has zero reflectance. The illuminating and observing apertures are also assumed to have zero reflectance. In the following work, it is also assumed that the observing and illuminating apertures are so small their plane areas can be considered equal to the spherical areas which they cut off.

DEFINITIONS

R = radius of sphere

$S = 4\pi R^2$ = area of complete sphere

c' = spherical area cut off by the test aperture

c'' = plane area of the test aperture

c_1 = sum of the area of observing and illuminating apertures

$a = S - c' - c_1$ = area of sphere remaining

r = reflectance of sphere coating

F = flux entering illuminating aperture

b_o = brightness of sphere walls due to reflected light only; black body at test aperture

b = brightness of sphere walls due to reflected light only; plate with same coating as sphere walls at test aperture.

Now, we equate the flux lost from the sphere with the incident flux-first for the black body, then for the plate at the test aperture. With the black body at the test aperture,

$$\text{First reflected flux escaping from the sphere} = rF \frac{c' + c_1}{S}$$

$$\text{Multiply reflected flux escaping from the sphere} = \pi b_o (c'' + c_1) - 2\pi b_o \frac{c' c_1}{S}$$

$$\text{Flux absorbed in the coating} = (1-r) \left(\frac{\pi b_o a}{r} + F \right)$$

$$\text{Then the incident flux, } F = \text{sum of the above} = F - rF \left(1 - \frac{c' + c_1}{S} \right)$$

$$+ \pi b_o \left(\frac{a}{m} - a + c'' + c_1 - \frac{2c' c_1}{S} \right)$$

Solving for b_o

$$b_o = \frac{r^2 F}{\pi S} \frac{a}{(1-r)a + r(c'' + c_1) - 2c' c_1 / S} \quad (1)$$

When the plate is at the test aperture:

$$\text{Flux received by the plate} = rF \frac{c'}{S} + \pi b \left(c'' - \frac{c' c_1}{S} \right)$$

$$\text{Flux received by the sphere walls} = F + \frac{\pi b a}{r}$$

therefore, the flux absorbed in the coating =

$$(1-r) \left[F \left(1 + \frac{rc'}{S} \right) + \pi b \left(\frac{a}{r} + c'' - \frac{c' c_1}{S} \right) \right]$$

$$\text{Flux escaping through } c_1 = rF \frac{c_1}{S} + \pi b \left(c_1 - \frac{c' c_1}{S} \right) \text{ (from sphere walls)}$$

$$+ r \left[rF \frac{c'}{S} + \pi b (c'' - c' c_1 / S) \right] \frac{c_1}{S} \text{ (from the plate)}$$

Again $F = \text{sum of the above terms}$. Solving for b , and neglecting a term in $(c_1/S)^2$ we have:

$$b = \frac{r^2 F}{\pi S} \frac{a + r c' (1 - c_1/S)}{(1-r) a + r \left(c'' + c_1 - \frac{2c' c_1}{S} \right) - r^2 (c'' - c_1 (c' + c'')/S)} \quad (2)$$

Then, taking the ratio b_o/b :

$$\frac{b_o}{b} = \frac{a \left[(1-r)a + r(c'' + c_1 - 2c' c_1/S) - r^2(c'' - c_1 (c' + c'')/S) \right]}{\left[a + r c' (1 - c_1/S) \right] \left[(1-r)a + r(c'' + c_1 - 2c' c_1/S) \right]} \quad (3)$$

This equation involves only the areas of apertures and the sphere walls and the reflectance of the sphere coating. So, a measurement of b_o and b will determine the reflectance.

Once r has been determined in this manner, samples of other materials can be placed at the test aperture. Calling the reflectance of the sample r' and the brightness of the sphere walls for reflected light with the sample at the test aperture b' , one can use the same method as before and write

$$\text{Flux received by plate} = rF \frac{c'}{S} + \pi b' \left(c'' - \frac{c' c_1}{S} \right)$$

$$\text{Flux received by sphere walls} = F + \frac{\pi b' a}{r}$$

therefore, flux absorbed in the coating =

$$(1-r') \left[rF \frac{c'}{S} + \pi b' \left(c'' - \frac{c' c_1}{S} \right) \right] + (1-r) \left(F + \frac{\pi b' a}{r} \right)$$

$$\text{Flux escaping through } c_1 = rF \frac{c_1}{S} + \pi b' \left(c_1 - \frac{c' c_1}{S} \right) \text{ (from sphere walls)}$$

$$+ r' \frac{c_1}{S} \left[rF \frac{c'}{S} + \pi b' \left(c'' - \frac{c' c_1}{S} \right) \right] \text{ (from the plate)}$$

Equating the sum of these terms to F, and solving for b'

$$b' = \frac{r^2 F}{\pi S} \frac{a + r' c' (1 - c_1/S)}{(1 - r)a + r (c'' + c_1 - 2c' c_1/S) - r' r [(c'' - c_1 (c' + c''/S))]} \quad (4)$$

Then the ratio b_o/b' is

$$\frac{b_o}{b'} = \frac{a \{(1 - r) a + r (c'' + c_1 - 2c' c_1/S) - r' r [(c'' - c_1 (c' + c''/S))] \}}{[a + r' c' (1 - c_1/S)] \{(1 - r) a + r [(c'' + c_1 - 2c' c_1/S)]\}} \quad (5)$$

which may be solved for r' .

It should be noted that the substitution in Equation (4) of $r' = r$ gives b , and $r' = 0$ gives b_o . Also, it can be seen that to make b' strongly dependent on r' , one should make c' large and $c_1 \ll c'$.

The flux reaching the detector is $\pi b' c_o$ where c_o is the area of the observing aperture and b' is given by Equation (4). When the reflectance of the coatings is determined, this expression gives the fraction of the flux entering the sphere which reaches the detector, that is, a sort of "transmission factor" for the sphere. It is, however, dependent on the geometry of the sphere as well as the reflectance of the coatings. This leads to the conclusion that to have a strong signal, c_1 should be large and c' small. This contradicts the requirement for high sensitivity.

The compromise, selected mostly on the basis of available detector sizes, is a sphere of radius 2 inches with a test aperture of radius 1 inch. The observing and illuminating apertures are both of radius 0.35 inch. The areas computed from these values were substituted in Equations (1) through (5), giving

$$b_o = \frac{F}{16\pi^2} \frac{r^2}{1 - .917r} \quad (1)$$

$$b = \frac{F}{16\pi^2} \frac{r^2(1+.072r)}{1-.917r .066r^2} \quad (2)$$

$$\frac{b_o}{b} = \frac{1-.917r - .066r^2}{(1-.917r)(1+.072r)} \quad (3)$$

$$b' = \frac{F}{16\pi^2} \frac{r^2 (1+.072r')}{1-.917r - .066r r'} \quad (4)$$

$$\frac{b_o}{b'} = \frac{1-.917r - .066r r'}{(1-.917r)(1+.072r')} \quad (5)$$

Measurement of b and b_o will permit the solution of Eq. (3) for r . Because of the equation's form, a graphical solution is the most convenient method. The ratio b_o/b is plotted as a function of r in Figure 2. Once r has been determined, Equation (5) can be solved for r' as a function of b'/b_o . To show the relation between r' and b'/b_o , Equation (5) was computed for several values of r' with $r = 1$. The resulting curve is shown in Figure 3.

2. Experimental. As theory indicates, the ratio b_o/b is measured at each wavelength in order to determine r . Then, measurements of b_o/b' are made to determine the reflectance of samples.

The integrating sphere used for the 1.0 to 3.5 micron region was made according to the design given above, i.e., a 4.000-inch diameter sphere with a 2.000-inch diameter test aperture, a 0.700-inch diameter entrance aperture and a 0.700-inch diameter detector aperture, located on mutually orthogonal radii of the sphere.

The sphere was made in two halves, from 6-inch x 6-inch x 3-inch blocks of half-hard aluminum. The halves were fitted together around a 4-inch ball. The surface discontinuity at the joint of the halves was about 0.001 to 0.002 inch and was easily covered by the MgO coating. With the ball in the spherical hole, the apertures were bored through; then the outside of the block was cut down until the apertures were approximately 0.003-inch deep. The sphere was coated with magnesium oxide by burning short pieces of magnesium ribbon first under the two halves separately, and then under the holes of the assembled sphere.

A battery-operated, automotive-type lamp is used as the illumination source for the sphere. It is imaged on the entrance aperture by a 70-millimeter focal length, f:0.7 spherical mirror. The light is chopped at 10 cycles per second. The detector is a 19 x 19 millimeter Kodak Type R2 lead selenide detector. The signal from the detector goes to a cathode follower which is used to match the input impedance of a Baird-Atomic type AQ-3 10-cycle amplifier. The cathode follower uses batteries for both plate and filament supplies to minimize noise. The signal from the amplifier is read with an oscilloscope.

A set of filters, placed at the entrance aperture, is used for wavelength selection. Except for the 1.0 micron filter which is Corning Glass No. 7-69, the filters are of the interference type. The reflecting coatings are multilayer combinations of germanium and cryolite. Additional filters are used in series with the band pass filters to obtain blocking over the entire region of sensitivity of the detector. The bandwidth of all the filters is approximately 0.2 micron.

C. NORMAL SPECTRAL EMISSIVITY 4.0 TO 13.5 MICRONS

1. Instrumentation. A block diagram of the instrument developed to make this measurement is shown in Figure 4. This instrument is a Baird-Atomic, Inc. double-beam infrared spectrometer which has undergone several modifications.

The 1,000-degree centigrade globar source and the entire servo system for beam-balancing have been removed. The source for one of the beams entering the monochromator is a room temperature black body. The source for the other beam is contained in a large aluminum cylinder which is maintained at a temperature of 90 degrees centigrade by thermostatically-controlled electric heaters. This heated source may be either a 1-inch diameter, a 3-inch deep cylindrical standard black body cavity in the block, or it can be a sample in a holder which fits into the black body cavity.

A 10-cycle chopper alternates the energy arriving from the two sources on the entrance slit of the monochromator. The energy difference between the two beams for the wavelength region selected by the monochromator develops a signal on the bolometer detector. This signal is amplified and measured.

Because of the low energies available from sources at the temperatures used, the monochromator slits have been set to the unusual width of 5 millimeters. Resolution for the monochromator with this slit width is given in the following table.

Wavelength (microns)	Resolution (microns)
4	0.45
6	0.30
8	0.22
10	0.18
12	0.15
14	0.13

2. Theory. The Planck radiation law for black bodies expresses spectral brightness as a function of wavelength and temperature. This function will be designated here by $J(\lambda, T)$. The spectral brightness of a material which is not a black body may be described by the product ϵJ , where $\epsilon(\lambda, T)$ is the emissivity of the material.

When radiation from the reference black body enters the monochromator, which is set to focus a wavelength λ_0 on the bolometer, the flux reaching the bolometer is

$$F_R = A \omega t J_R \Delta\lambda \quad (1)$$

where A is the area of the bolometer

ω is the angular aperture of the optical system at the bolometer

t is the transmission of the optical system

$\Delta\lambda$ is the resolution of the monochromator at the wavelength λ_0 for which it is set.

Similarly, the flux from the standard black body is

$$F_B = A \omega t J_B \Delta\lambda \quad (2)$$

When the standard black body is replaced by the sample, the flux obtained is

$$F_S = A_{\text{wt}} \left[\epsilon_s J_s + (1-\epsilon_s) J_R \right] \Delta\lambda \quad (3)$$

where the second term is due to the reflectivity of the sample.

A signal from the bolometer is caused by the difference in flux between the two beams; i.e., $S = G K_E \Delta F$ where G is the amplifier gain and K_E a conversion factor from energy difference to voltage.

In one case, the reference black body and the standard black body are used and the signal is

$$S_B = G K_E A_{\text{wt}} \Delta\lambda (J_B - J_R) \quad (4)$$

A signal is also obtained with the reference black body and the sample, giving

$$\begin{aligned} S_s &= G K_E A_{\text{wt}} \Delta\lambda \left[\epsilon_s J_s + (1-\epsilon_s) J_R - J_R \right] \\ S_s &= G K_E A_{\text{wt}} \Delta\lambda \left[\epsilon_s (J_s - J_R) \right] \end{aligned} \quad (5)$$

Taking the ratio of (5) (6)

$$\frac{S_s}{S_B} = \frac{\epsilon_s (J_s - J_R)}{J_B - J_R} \quad \text{or} \quad \epsilon_s = \frac{S_s}{S_B} \frac{J_B - J_R}{J_s - J_R} \quad (6)$$

If the standard black body and the sample are at the same temperature and the reference black-body temperature is constant, the emissivity is just the signal ratio. In general, this is not the case, and the J 's must be computed from Planck's law to be used as a correction factor on the signal ratio. For the work done so far, this factor has ranged between 0.8 and 1.2.

The radiation law is

$$J(\lambda, T) = \frac{C_1 \lambda^{-5}}{e^{C_2/\lambda T} - 1} \quad (7)$$

where C_1 and C_2 are constants and $C_2 = 14384\mu^{\circ}\text{K}$.

Substituting (7) in the equation for E_s gives

$$\epsilon_s = \frac{s_s}{s_B} \left[\begin{array}{cc} \frac{1}{C_2} & \frac{1}{C_2} \\ \frac{e^{\lambda_o T_B} + 1}{e^{\lambda_o T_R} - 1} & \frac{e^{\lambda_o T_R} - 1}{e^{\lambda_o T_B} + 1} \\ \frac{1}{C_2} & \frac{1}{C_2} \\ \frac{e^{\lambda_o T_S} - 1}{e^{\lambda_o T_R} - 1} & \frac{e^{\lambda_o T_R} - 1}{e^{\lambda_o T_S} - 1} \end{array} \right] \quad (8)$$

This was rearranged and computed in the form

$$\epsilon_s = \frac{s_s}{s_B} \left[\begin{array}{ccc} \frac{C_2}{e^{\lambda_o T_R} - e^{\lambda_o T_B}} & \frac{C_2}{e^{\lambda_o T_S} - 1} & \frac{C_2}{e^{\lambda_o T_S} - 1} \\ \frac{C_2}{e^{\lambda_o T_B} - 1} & \frac{C_2}{e^{\lambda_o T_R} - e^{\lambda_o T_S}} & \frac{C_2}{e^{\lambda_o T_S} - 1} \\ e^{\lambda_o T_B} - 1 & e^{\lambda_o T_R} - e^{\lambda_o T_S} & e^{\lambda_o T_S} \end{array} \right] \quad (9)$$

D. NORMAL TOTAL EMISSIVITY AT 275 DEGREES KELVIN

1. Theory. Because of the limited energy emitted and the low sensitivity of detectors for long wavelengths, the measurement of total emissivity at low temperatures was selected as the method of providing information about spectral emissivity at long wavelengths. A bolometer which has a constant spectral sensitivity to beyond 60 microns is used as the detector. A chopper is used to interrupt the radiation from the sample so an ac signal is obtained from the bolometer. The signal amplitude is proportional to the difference in energy received by the

bolometer when exposed to the chopper blade and the sample. To relate signal amplitude to emitted energy rather than energy difference, a signal is also obtained from a black body whose emission can be calculated.

To show the relation of the signal amplitude to the emissivity of the sample, the energy differences which produce the signals will be written as integrals with respect to wavelength. For simplicity, it will be assumed the chopper and the enclosure containing the apparatus are at the same temperature, T_R , and the sample and black body are both at some other temperature, T_S . The Planck black body radiation function is $J(\lambda, T)$. The emissivity is $\epsilon_c(\lambda)$. The subscripts c, s, and b indicate chopper, sample, and black body, respectively.

The energy from the chopper is

$$w_c = \int_0^{\infty} \epsilon_c(\lambda) J(\lambda, T_R) d\lambda \quad (\text{emitted})$$

$$+ \int_0^{\infty} [1 - \epsilon_c(\lambda)] J(\lambda, T_R) d\lambda \quad (\text{reflected}) \quad (6)$$

$$w_c = \int_0^{\infty} J(\lambda, T_R) d\lambda = \sigma T_R^4$$

For the black body the energy is just

$$w_b = \int_0^{\infty} J(\lambda, T_S) d\lambda = \sigma T_S^4 \quad (7)$$

For the sample

$$W_s = \int_0^\infty \epsilon_s(\lambda) J(\lambda, T_s) d\lambda \quad (\text{emitted})$$

$$+ \int_0^\infty [1 - \epsilon_s(\lambda)] J(\lambda, T_R) d\lambda \quad (\text{reflected})$$

$$W_s = \int_0^\infty J(\lambda, T_R) d\lambda - \int_0^\infty \epsilon_s(\lambda) J(\lambda, T_R) d\lambda + \int_0^\infty \epsilon_s(\lambda) J(\lambda, T_s) d\lambda \quad (8)$$

Letting K denote a constant that includes area of source, solid angle of the optical system, the gain of the amplifier and the conversion factor of the bolometer from energy difference to voltage, the signals are

$$S_b = K(W_c - W_b) = K \left[\int_0^\infty J(\lambda, T_R) d\lambda - \int_0^\infty J(\lambda, T_s) d\lambda \right] = K \sigma (T_R^4 - T_s^4) \quad (9)$$

and

$$\begin{aligned} S_s = K [W_c - W_s] &= K \left[\int_0^\infty J(\lambda, T_R) d\lambda - \int_0^\infty J(\lambda, T_R) d\lambda + \int_0^\infty \epsilon_s(\lambda) J(\lambda, T_R) d\lambda \right. \\ &\quad \left. - \int_0^\infty \epsilon_s(\lambda) J(\lambda, T_s) d\lambda \right] \\ S_s &= K \left[\int_0^\infty \epsilon_s(\lambda) [J(\lambda, T_R) - J(\lambda, T_s)] d\lambda \right] \end{aligned} \quad (10)$$

Taking the ratio of signals

$$\frac{S_s}{S_b} = \frac{\int_0^{\infty} \epsilon(\lambda) [J(\lambda, T_R) - J(\lambda, T_S)] d\lambda}{\int_0^{\infty} [J(\lambda, T_R) - J(\lambda, T_S)] d\lambda} \quad (11)$$

The total emissivity is defined as

$$E(T) = \frac{\int_0^{\infty} \epsilon(\lambda) J(\lambda, T) d\lambda}{\int_0^{\infty} J(\lambda, T) d\lambda} \quad (12)$$

Substituting (12) in (11) gives

$$\frac{S_s}{S_b} = \frac{E(T_R) T_R^4 - E(T_S) T_S^4}{T_R^4 - T_S^4} \quad (13)$$

Here both $E(T_R)$ and $E(T_S)$ are unknown. Since T_R and T_S differ only by about 20 degrees Kelvin, we make the assumption that $E(T_R) = E(T_S)$. Then we have simply $E = S_s/S_b$. (14)

2. Instrumentation. The apparatus built for this measurement is shown in Figure 5. The bolometer used in this apparatus has no window in order that it may have flat response to 60 microns. Two field stops are used so the bolometer "looks" at only the center of either the sample or the black body. The central 45-degree mirror can be rotated so either the sample or the black body is in the field of view.

The entire apparatus is enclosed in a vacuum chamber for several reasons. First, this reduces the gas pressure on the bolometer strip to near the optimum. Second, it prevents moisture condensation of the samples that are cooled to almost 0 degrees centigrade. Third, it greatly reduces atmospheric absorption.

Design of the sample holder and black body was complicated by the requirement that they make a vacuum seal at the base plate while at the same time providing good thermal insulation for the sample and black body cavity from the base plate which is effectively an infinite heat sink at room temperature. The design used is shown schematically in the figure. The flange which makes the seal to the base plate is silver soldered to a 0.040-inch wall, 3-inch long Monel tube. The bottom of the tube is silver soldered to a flange on the copper rod which holds the sample or black body cavity. The exposed end of the rod is immersed in the coolant and, because of the low conductivity and small cross-section of the Monel tube, reaches an equilibrium temperature within a few degrees of the coolant temperature.

E. OTHER INSTRUMENTS USED

Two instruments available for general use in this laboratory have been used occasionally when it was thought they could provide useful information.

1. Baird-Atomic, Inc. Type 4-55 Infrared Recording Spectrophotometer. This instrument has been used for spectral transmission measurements in the range of 2 to 16 microns. Since all methods of measurement used on this contract assume an opaque sample, transmission measurements are sometimes necessary to indicate the wavelength range over which samples (e.g., mica) are opaque.

The Infrared Recording Spectrophotometer has an attachment that measures specular reflectivity for a 30-degree angle of incidence. This is not an absolute measurement because the data obtained must be referred to the reflectivity of a mirror which is not precisely known. However, it is occasionally helpful to compare the shape of a reflectivity curve to that of the spectral emissivity data.

2. Baird-Atomic, Inc. Type BR-1 One-Meter Grating Monochromator. This instrument, with a CaF₂ foreprism, photomultiplier and PBS detectors, has been used to measure spectral transmission in the range 0.4 to 2.0 microns. It uses a 4-inch, 5,000-line-per-inch grating as its principal dispersing element.

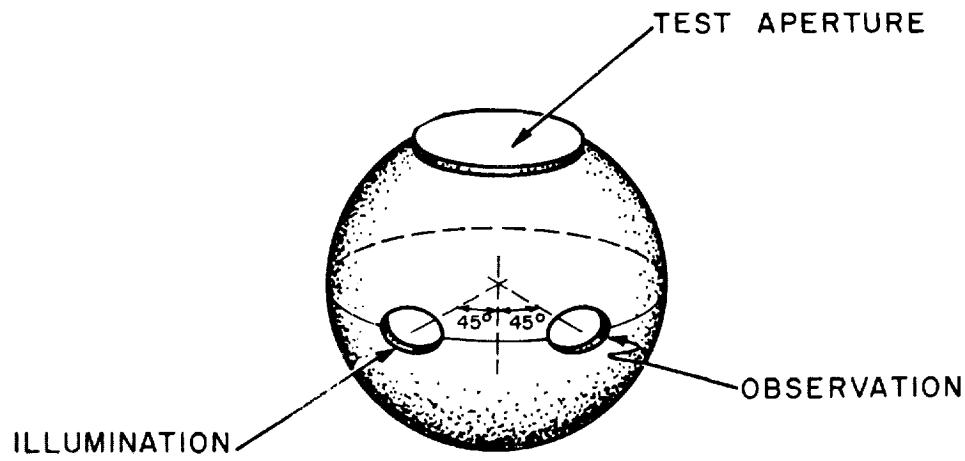
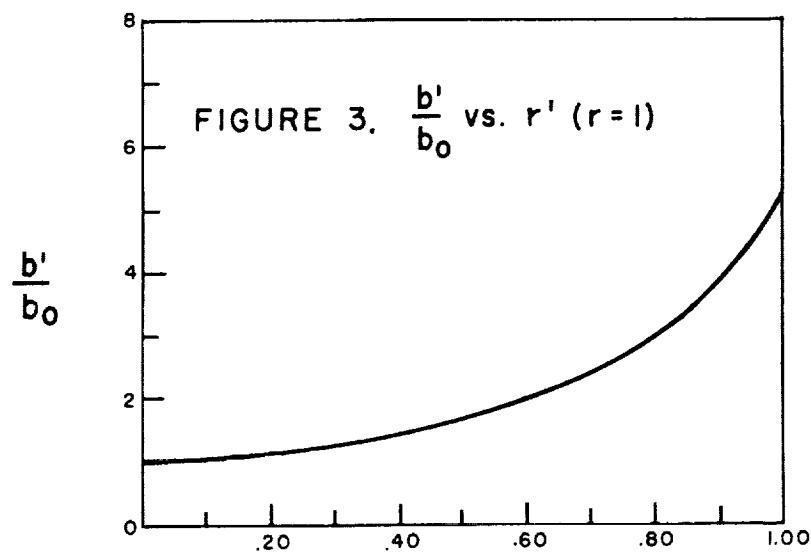
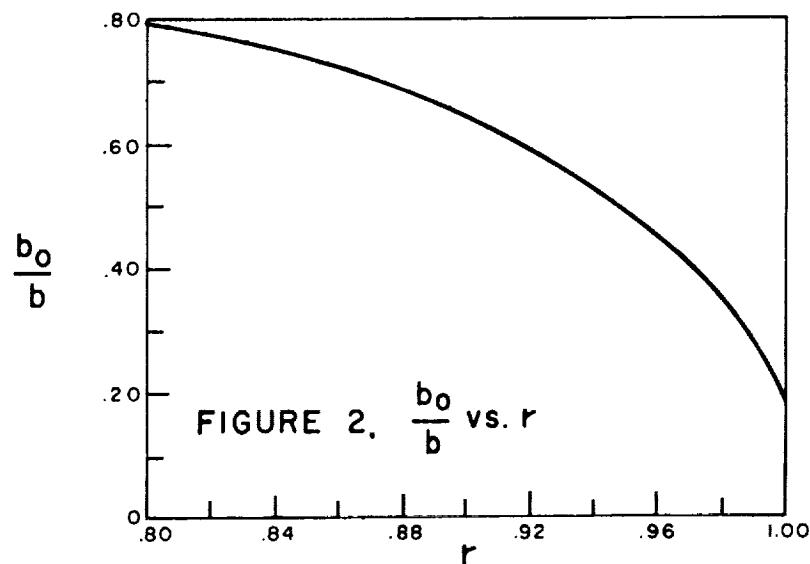


FIGURE 1. PRESTON TYPE INTEGRATING SPHERE



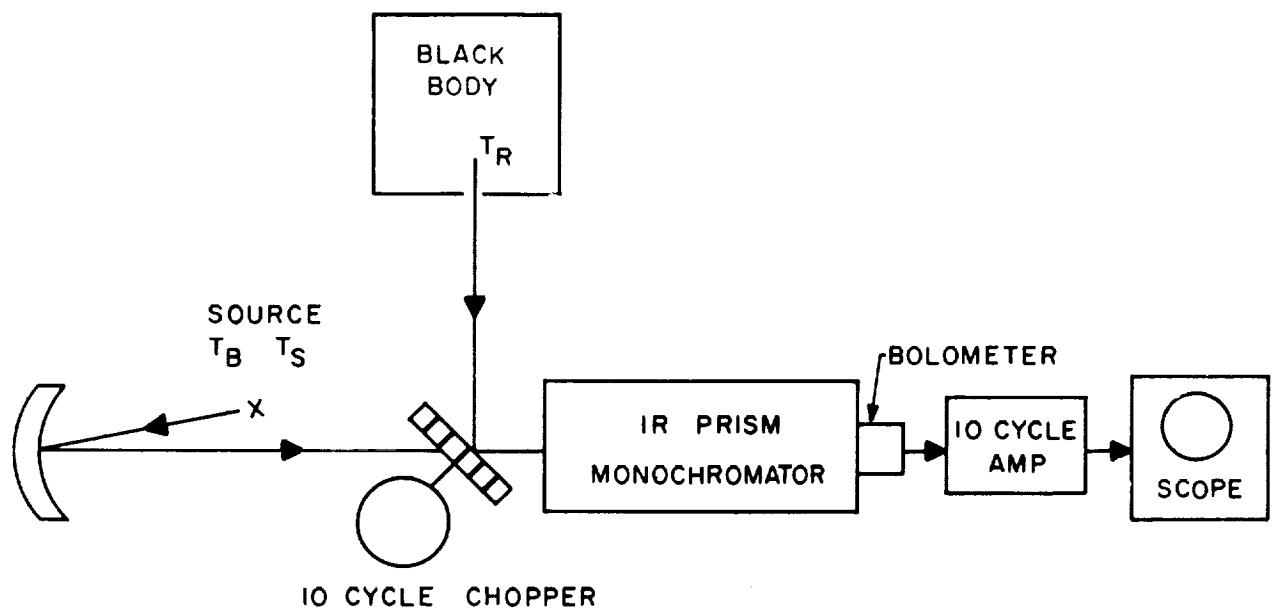


FIGURE 4. SPECTRAL EMISSIVITY APPARATUS

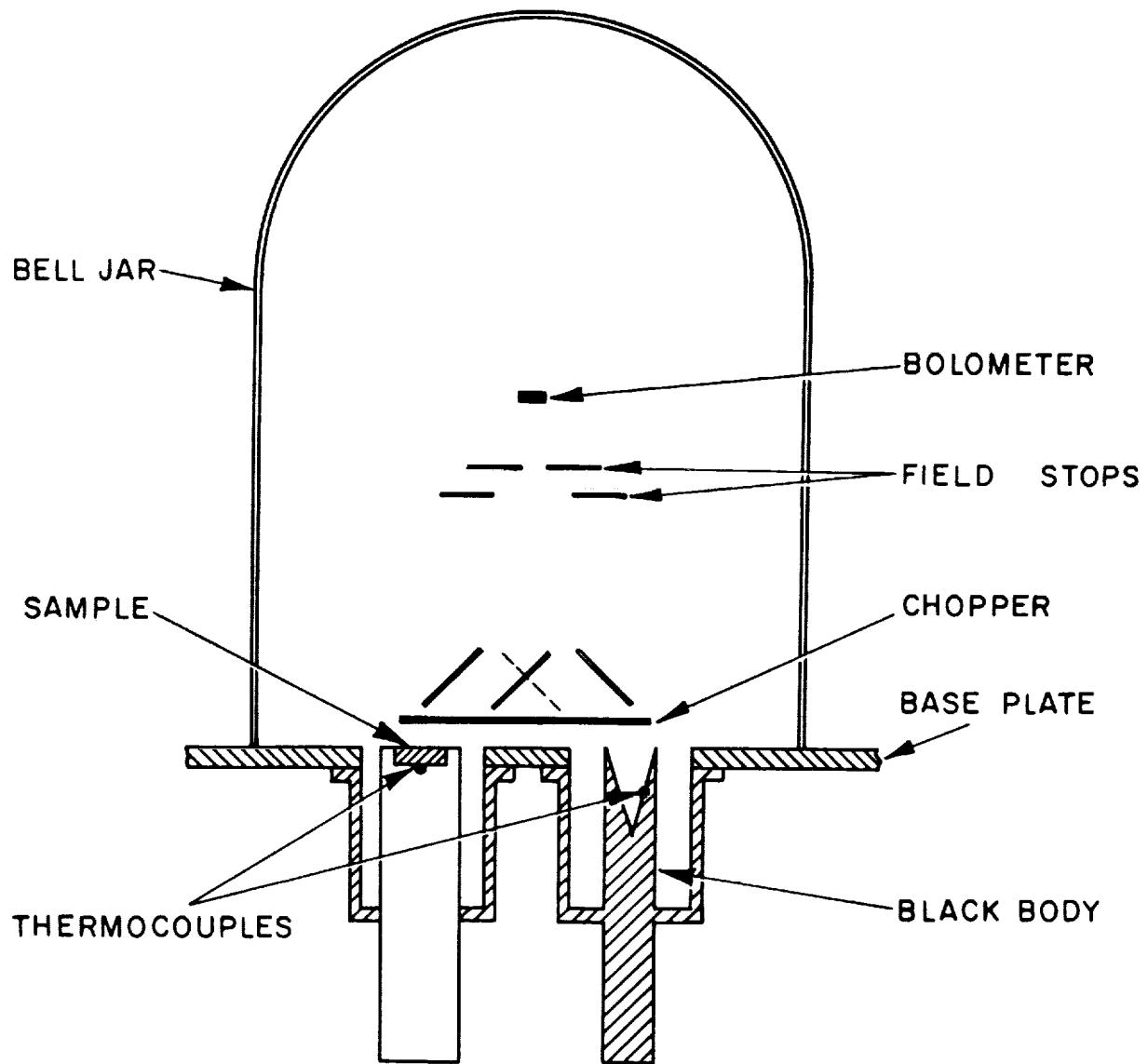


FIGURE 5. TOTAL EMISSIVITY APPARATUS

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<p>NASA TN D-1116 National Aeronautics and Space Administration. THE RESULTS OF EMITTANCE MEASUREMENTS MADE IN RELATION TO THE THERMAL DESIGN OF EXPLORER SPACECRAFT. Ronald Merrill, William Snoddy, and Klaus Schocken. May 1962. 147p. OTS price, \$2.75. (NASA TECHNICAL NOTE D-1116)</p>	<p>This note consists of a summary of the emittance measurements made thus far by Baird-Atomic, Incorporated, under contract DA-19-020-ORD -4474, and supervised by Dr. Klaus Schocken of MSFC's Research Projects Division. Spectral emittance measurements were made over the range of 0.4 to 13.5 microns and total normal measurements were made at 275° K. An excerpt from the "Final Technical Report" by R. McDonough, director of the project at Baird-Atomic, Incorporated, is given as an appendix to this note.</p>	<p>NASA</p>	<p>I. Merrill, Ronald II. Snoddy, William III. Schocken, Klaus IV. NASA TN D-1116 (Initial NASA distribution: 25, Materials, engineering; 26, Materials, other; 47, Satellites.)</p> <p>NASA TN D-1116 National Aeronautics and Space Administration. THE RESULTS OF EMITTANCE MEASUREMENTS MADE IN RELATION TO THE THERMAL DESIGN OF EXPLORER SPACECRAFT. Ronald Merrill, William Snoddy, and Klaus Schocken. May 1962. 147p. OTS price, \$2.75. (NASA TECHNICAL NOTE D-1116)</p> <p>This note consists of a summary of the emittance measurements made thus far by Baird-Atomic, Incorporated, under contract DA-19-020-ORD -4474, and supervised by Dr. Klaus Schocken of MSFC's Research Projects Division. Spectral emittance measurements were made over the range of 0.4 to 13.5 microns and total normal measurements were made at 275° K. An excerpt from the "Final Technical Report" by R. McDonough, director of the project at Baird-Atomic, Incorporated, is given as an appendix to this note.</p>
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